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The proposed rapid transit scheme was submitted to popular vote in Boston on Nov. 7, and was defeated by a majority of 3,119 out of 51,000 votes. The general impression was, says the Boston "Herald," that the scheme was financially impracticable and of questionable advantage to the citizens.

An armor-piercing mortar shell made by the Sterling Steel Co., of Pittsburg, has been successfully tested at Sandy Hook. Two projectiles were fired from a 12-in. mortar at a 4½ in. plate set at an angle of 60° to the horizon. This plate represented the deck of a ship under normal firing conditions, and in both cases the projectiles pierced it without breaking up, and with only a slight upsetting of the end. It is said that the company will at once proceed to turn out a number of them for acceptance by the War Department.

An edition de luxe of "The World's Rail Way," the publication announced in our issue of Sept. 14, 1893, as in preparation by Maj. J. G. Pangborn, to describe the remarkable exhibit collected by him for the Baltimore & Ohio R. R., is to be issued by subscription only at $25 each, printed on vellum and with 153 plates in colors and as many more uncolored. It is announced that in no event will either this or the ordinary edition be placed on sale, and that those desiring copies must subscribe in advance. We need not say that both the collection and the book describing it have great and special interest, and that the one is, and the other is likely to be, unique and unequaled in its way. Subscriptions may be sent to the author at Baltimore, Md.

The official trial of the protected cruiser "Columbia," which takes place this week, has for its chief outcome an expected development of very high speed, due to her 21,000 horse-power engines. The triple screws with which this ship is provided, while unusual, are not a wholly new departure in the machinery of warships. France so equipped the "Depuy de Lome," an armored cruiser of 6,297 tons displacement, in 1890. The same nation has also two battleships of 11,700 tons with triple screws. Germany has one protected cruiser of 6,052 tons, the "Kaiserin Augusta," launched in 1892, and Italy has seven torpedo cruisers, of from 740 to 840 tons displacement, also provided with triple screws. The "Confienza," the oldest of the Italian ships, was launched in 1887. The chief purpose of the triple screw arrangement is the more economic and safe transmission of a proportionally enormous engine power through a larger number of shafts, and also economy in cruising and greater safety to machinery.

The U. S. cruiser "Columbia" made a preliminary run over the 44-knot trial course off the Massachusetts coast on Nov. 14, covering the distance in 1 hr. 55 min. 34 sec., an average speed of 22.87 knots per hour. During the run the engines made 132 to 136 revs. per minute, and at one time it is stated that a speed of 24 knots an hour was reached. The engines are said to be capable of making 138 revs., and it is expected that the speed on the official trial will exceed 23 knots.

A mean speed of 26¼ knots for three hours was attained at the late trial of the torpedo boat "Havock," built by Messrs. Yarrow & Co., for the English navy. The "Havock" is 180 ft. long, 18½ ft. beam and about 200 tons displacement. She has two sets of triple-expansion engines, with 18, 26 and 39½ in. cylinders and 26 in. stroke, designed to give 3,000 HP. at 400 revolutions per minute. The twin screws are 6 ft. 2 in. in diameter. The two boilers are of the locomotive type, with forced draft, and a working pressure of 180 lbs. per sq. in. The battery consists of one 12-pdr. and three 6-pdr. rapid-fire guns. She has one fixed bow torpedo tube and two revolving deck tubes 18 ins. in diameter. Messrs. Yarrow & Co. are building a sister ship, the "Hornet," which is to have Yarrow's tubulous boilers, and the speed expected is 27 knots.

The Columbian Exposition finances are reported upon as follows, up to Nov. 9, by Treasurer Seeberger; omitting some of the smaller items in the detail:

Total receipts		$33,401,543
Stock subscriptions	$5,512,972	
Gate receipts	10,576,208	
City of Chicago bonds	5,003,726	
Debentures, 6%	4,444,500	
Concessions	3,365,603	
Souvenir coins	519,765	
Premiums on above	519,379	
Special souvenir coin fund account	1,435,000	
Miscellaneous receipts	1,704,239	
Souvenir coins on hand	214,872	
Total expenditures		$31,031,585
Balance general fund		2,153,128
Face value of coins on hand		214,872

The Nansen polar expedition is said to start out under very favorable auspices. According to the "Pall Mall Gazette," Norwegian seal-hunters report that the Kara Sea, through which Dr. Nansen sailed north on Aug. 4, has never been known before to be so free of ice. Over areas of 20 and 30 miles there was no ice at all, when there is usually an ice-choked sea.

The most serious railway accident of the week was a rear collision Nov. 8 at 71st St., Chicago, on the Chicago, Rock Island & Pacific R. R. A southbound accommodation train for Blue Island had stopped at the Eggleston station, 71st St. and Wentworth Ave., and was run into by a vestibule express train for Kansas City. The rear car of the accommodation train was telescoped by the locomotive, and in its turn telescoped the second car. Six persons were killed and 30 injured. The wreck caught fire, but the flames were extinguished by the fire department. A dense fog prevailed at the time, and the railway officials asserted that the engineman of the express had been warned to run carefully.——A head collision occurred Nov. 9 on the Columbus, Hocking Valley & Toledo R. R. near Rising Sun, O., and four persons were killed. Disregard of orders was the cause.

The North Chicago Street Ry. Co.'s car barn at Racine Ave. and Center St., Chicago, was burned Nov. 8, and 38 cars and 15 Connelly gas motor cars were destroyed. The thick fog prevailing at the time prevented the firemen from getting promptly to the fire. Only one of the motors was charged, and it is said that a leak of gas from its tank caught fire from a match lighted by a motorman who was looking for the leak. Gasoline was the source of the gas used on the Connelly motor cars a year or more ago. It was at one time proposed to change to compressed gas, on account of the odor from the gasoline. We are not aware that the change was ever made.

The Manhattan elevated railway system in New York. in its last annual report, gives the following comparative statement of business for three years:

	1892-3.	1891-2.	1890-1.
Gross earnings	$11,137,050	$10,908,578	$10,174,935
Operat'g expenses	6,210,159	5,964,888	5,608,029
Net earnings	$4,926,890	$4,943,689	$4,566,906
Fixed charges	2,015,075	1,963,743	1,916,080
Balance	$2,917,816	$2,979,946	$2,650,826
Dividends, 6%	1,800,000	1,800,000	1,680,000
Surplus	$1,111,816	$1,179,946	$970,826

The increase in operating expenses is attributed to heavy payments of taxes, it being stated that all such items have been included in the working cost. It will, however, be seen that the balance of income applicable to dividends is equivalent to only 9.7% on the stock as against 9.9% so applied in 1891-92.

The United States cruiser "Olympia," built by the Union Iron Works, of San Francisco, Cal., made in her contractor's trial trip at sea 21.26 knots. Her average for 68 knots in a heavy sea and strong head wind was slightly under 21 knots.

The Bass River Canal Co. has been incorporated in Massachusetts to construct the Cape Cod ship canal by Benj. J. Berry, Wm. F. Humphrey, Thos. I. Winsor and others. The company is a rival to the Old Colony & Interior Canal Co., chartered for the purpose of constructing this canal by the last legislature.

The development of water power at Keewatin, Man., is reported as having just been started by the newly organized Keewatin Power Co., of which John Mather, of Ottawa, Ont., is vice-president and resident manager; John Kennedy, consulting engineer, and Wm. Kennedy, engineer in charge. It is stated that dams will be built in the Winnipeg River near the Lake of the Woods.

Steel rails are now offered by the Carnegie Steel Co. at $24 per ton, a clean cut of $5. An official of the company says this was done because of the stagnant condition of the steel business and because of the large scale upon which this company manufactures steel rails. In so doing the Carnegie Co. goes out of the Steel Rail Association and sets its own price.

Ironbark timber, referred to in our issue of Oct. 19, in an article on bridge building in New South Wales, is a species of the eucalyptus, to which family all the Australian hard woods belong. There are five kinds of it in New South Wales and it is the best of the hard woods of that colony in combined endurance and strength. Botanically considered, the principal ironbarks are as follows: White or she-iron bark (Eucalyptus paniculata); narrow-leaf (Eucalyptus crebra); broad-leaf (Eucalyptus siderophaloia), and the red ironbark (Eucalyptus sideroxylon). This information is given in answer to queries received.

A mining and metallurgical exhibition is to be held at Santiago, Chile, in 1894, and a law has been passed appropriating $150,000 toward the expenses. American exhibitors should make their applications through the Chilean legation at Washington, and all exhibits must be in Valparaiso or Santiago by March 15, 1894. The exhibits will be divided into eight classes, as follows: Motor machinery, electricity, extracting machinery, machinery for the preparation of minerals, metallurgy, chemical industries, statistics and plans, and products of the working of mines and of metallurgy. The exhibition will be under the management of the Minister of Public Works and the National Society of Mines. The awards will be made on the jury system, and will be of three classes.

Nicaragua Canal finances are set forth as follows by Mr. Hiram Hitchcock, president of the Maritime Canal Co., in his report to the Secretary of the Interior: Since the organization of the company 10,145 shares of its capital stock have been subscribed for, and the sum of $1,014,500 realized. Of this sum $1,006,940 has been paid into the treasury in cash, and $48,871 was realized from other sources, making the total cash received $1,055,811. Since its organization the company has paid out $830,788 in cash and 31,990 shares of full paid capital stock for property, works and labor, materials furnished and administration expenses. This stock represents a par value of $3,199,000, and the company is further obligated on the above account for $6,855,000 of its first-mortgage bonds. The company has also issued 180,000 shares of stock, of the par value of $18,000,000, in payment of concessionary rights, privileges, franchises and other property. The liabilities consist of the amounts still due under the concessions granted, the $6,855,000 of bonds and cash liabilities not exceeding $50,000. The late financial depression caused the suspension of all payments and the appointment of a receiver; but measures are now under way, with every assurance of successful issue, for reorganizing the company upon a strong financial basis and for paying all its debts and the active prosecution of work.

The Canadian Atlantic Cable Company, Mr. R. R. Dalsell, president, is again agitating the laying of a direct cable between Canada and Great Britain, and is seeking to induce the Dominion government, in the coming session, to grant a subsidy. The company claims to have $500,000 of the $2,500,000 capital required paid in; but it hopes that England will also assist the enterprise. Mr. Dalsell has received an offer to lay the cable, which would commence at the Straits of Belle Isle and terminate on the west coast of Ireland.

AMERICAN IRON AND STEEL EXHIBITS AT THE COLUMBIAN EXPOSITION.

"What impressed you most at the Fair?" is a question which has been on every one's tongue the past summer, when talking with pilgrims returning from the White City at Chicago. The answer was almost invariably the same, in substance: "The buildings themselves." So, if one were asked what was the display at the Fair which was most creditable to and best representative of America's iron and steel industries, the true answer would name no single exhibit, but instead those wonderfully wrought steel trusses which carried the roofs of the great buildings grouped around the Court of Honor. In its excellence of design, from the standpoint of the artist as well as the engineer, in the lofty magnitude of the work, and even more in the brief time in which each great structure was put through all its stages from preliminary design to final completion, the ironwork of the Columbian Exposition buildings is a landmark of high achievement. In this class of iron and steel work, at least, American firms fear no comparison with the productions of any other country; the noble trusses of the Manufactures' Building, especially, are a triumph of engineering which any nation in the world would be proud to claim.

Aside from the ironwork of the buildings themselves, there was little to show to the visitor America's rank in the production and working of structural metal. The New Jersey Steel & Iron Co. had an exhibit in the Transportation Building, in which was a section of the top chord of a 440-ft. span built for the St. Louis, Keokuk & Northwestern R. R. bridge over the Missouri River, and a fine working model of the draw span for the Chicago, Burlington & Quincy bridge over the Mississippi, at Burlington, Ia. An expansion plate for the first-named bridge with ten 5-ft. rockers, which could be easily moved with a finger's pressure, was an excellent example of good workmanship. The company is using on some of its large pin-connected structures, hollow pins, having a 1-in. hole bored through them. A rod passes through this hole and nuts on its ends keep the pin in place instead of nuts screwed on the pin itself, as in ordinary practice. The Union Bridge Co. showed some 10-in. eyebars which had been tested to destruction. One of them failed under a pull of 1,152,375 lbs., a weight so great that it can be better comprehended by saying that it is just about equal to the total weight of the heaviest New York Central express train, made up of a 100-ton locomotive and a dozen Wagner cars.

To the Bethlehem Iron Co. must be awarded the credit of having made the showing at Chicago which caused most surprise to foreign visitors unacquainted with American achievements in iron and steel production. The reproduction of its mammoth steam hammer, which spanned the main aisle in the Transportation Building, was one of the spectacles of the exhibition, and a revelation to most visitors as an example of the magnitude of modern steel working machinery. It was a pity that the Carnegie Company did not reproduce its great armor plate mill in the same way.

Bethlehem's achievements in armor plate are pretty well known to engineers, so we may pass over their exhibits in this class; but its work in heavy steel forging is not as well known, and the great pieces of shafting which the big hammer has turned out attracted great attention and well deserved the abundant praise which they received. The two most remarkable pieces were a hollow shaft for the Fall River steamer "Puritan," 39 ft. 5 ins. long, 27 ins. diameter, and with a hole 9 ins. in diameter through it. Its total weight was 69,500 lbs. A piece of hollow propeller shafting was 67 ft. long, 20 ins. outer and 8¼ ins. inner diameter, and weighed 55,200 lbs. Beside these mammoth forgings was a huge steel ingot, weighing 108,190 lbs. We still meet people who talk of the treachery of steel and sigh for the days of wrought iron; but who that contrasts the process of making one of these big steel shafts with the old process of making wrought iron shafts, can fail to be impressed with the difference. The iron shaft was built up by welding together bloom after bloom, the blooms themselves being built up of billets or piles of scrap iron heated and forged to the proper shape. The steel shaft is drawn down under the great hammer from a single ingot, and the innumerable chances for flaws and imperfect welds which had to be taken with the old iron shaft no longer exist. The 12-in. rifle of Bethlehem steel, made at the naval gunshops, was another article in the exhibit deserving special mention, and served to show the high class of work done at Washington, as well as the grade of metal which the Bethlehem works can produce.

The Cambria Iron Co.'s exhibit in the Mining Building, though not large, was an interesting one, especially in its display of merchant steel, plow point steel and other specialties, and in the fractures of billets and ingots, some of which showed metal treated in the Krupp washer, which is still in use at these works.

In crucible steel two Pittsburg firms, Singer, Nimick & Co., and the Crescent Steel Co., had the field pretty much to themselves. The former firm's exhibit of self-hardening steel was especially good. It is to be regretted that more American makers of high-grade cutlery and tool steel did not think it worth while to make an exhibit. We are constantly told that American steel makers can turn out metal equal to anything which Europe can produce, and it was a pity to have so small a display by United States producers in this department to match the wonderful exhibits of some of the foreign cutlery makers. One firm in particular, which has furnished large quantities of high grade tool steel and ordnance material to the government, could have made an exhibit which would have surprised our foreign visitors, and it is to be regretted that the opportunity was not embraced.

An exhibit in special steels which was highly creditable was that of the Chrome Steel Co., of Brooklyn. This firm was the pioneer, not only in this country but in the world, in chrome steel manufacture on a commercial scale, and it has well deserved its continued success. Its exhibit comprised a large number of worn out chrome steel shoes from stamp mills, each marked with its date of beginning and ending service, and accompanied by samples of the ore on which work was done. Some of these shoes weighing, when new, 100 lbs. and measuring 8 ins. in length, ran for 180 days (of 24 hours each), and were removed when worn to a length of only ½ in. Another use of chrome steel is for the manufacture of safes, the metal being made so hard as to resist a drill and rolled between sheets of wrought iron which prevent its being cracked. This is, perhaps, the most important use to which chrome steel has thus far been put. Since spinning came into prominence as a method of working sheet metals, dies for spinning have been made of chrome steel with great success.

The Tyler Tube & Pipe Co., of Washington, Pa., had an exhibit at the Lakewood convention of the Master Mechanics' and Car Builders' associations, last summer, which was afterward taken to Chicago, and was a remarkable illustration of the excellence of the finest quality of wrought iron made from charcoal pig. The company's specialty is wrought iron boiler tubes, and the exhibit consisted of pieces of tube which had been worked cold with a ball-peen hammer into various shapes. One had been brought to the shape of a goblet; another had been expanded to a flat disk. The diameter of the tube was doubled in some cases by the working, and the metal was brought down to remarkable thinness. The exhibit showed a quality of metal quite equal to that shown in the cases of the Yorkshire exhibitors.

In the annex of the Transportation Building, in a regrettably out-of-the-way corner, the Continental Iron Works, of Brooklyn, had a most interesting exhibit of a class of work of which little has yet been done on this side of the water. We refer to the welding of seams in heavy plates. As is pretty well known, this firm is the sole maker in the United States of corrugated boiler furnaces. Its exhibit included two such furnaces, one 22 ft. 3 ins. long, 42¾ ins. inside diameter, and ⅝ in. thick; the other 58 ins. inside diameter. In making these furnaces the plate is first bent into a cylindrical form and the seam is welded. The cylinder is then heated and put through rolls which form the corrugations. The welding of seams in plates has been practiced at the Continental Iron Works for nearly a quarter of a century; but the last few years has seen great improvements in the process and great extension in its use. Gas has replaced coal as a fuel, the use of a "glut-piece" at the weld has been abandoned, and the junction of the plates is effected by a roller working under hydraulic pressure instead of by the old method of hand hammering. This plant is now able to turn out boiler shells with both horizontal and circumferential seams welded instead of riveted, and its officers look to see welding largely supersede riveting in boiler work. One of the pieces shown in the company's exhibit was a welded steel steam pipe 17 ins. inside diameter, 14 ft. long and 5-16 in. thick for the U. S. Cruiser "Columbia." Calling the ultimate strength of the metal 55,000 lbs. per sq. in., this pipe would sustain an internal pressure of 2,022 lbs. The substitution of welded steel pipes for the copper pipes so long employed for use on shipboard bids fair to effect great results for both safety and economy.

To the engineer interested in the progress of iron and steel metallurgy in this country, the exhibits by the various makers of steel castings was a most interesting feature of the exhibition. Most of these were in the Transportation Building, the car coupler business furnishing a goodly percentage of the business of American steel founders at the present time. The Sargent Company, of Chicago, showed a heavy gear wheel 5½ ft. in diameter. The surface of the casting was rather rough; but the metal was solid and free from blowholes. Among the other excellent pieces in the exhibit were a crankshaft 6¾ ins. diameter, and some small cut gears and engine crossheads. Pratt & Letchworth, of Buffalo, showed a very large and heavy crankshaft, and a heavy engine crosshead. The American Steel Wheel Co., of Garwood, N. J., which is now the only firm making cast steel car wheels in this country, had an excellent exhibit, comprising locomotive driving wheels, passenger car wheels and wheels for electric cars. The Otis Steel Co. showed some heavy pinions about 20 ins. in diameter, with helical teeth. intended for rolling mill service. The most complete and interesting exhibit of any American steel foundry, however, was made by the Solid Steel Co., of Alliance, O., in a rather contracted space in the Mining Building. As showing the high grade of metal which can now be secured in a steel casting, samples were exhibited which had been cut from large castings and groken in a testing machine. The tensile strength and elongation of several samples were as follows:

Tensile strength, lbs. per sq. in.	P. c. elongation in 8 ins.
106,138	17
76,413	27.5
72,051	28.5
66,224	31
63,072	25
61,092	34.2

One of the coupler knuckles shown in the exhibit had one of its lugs drawn out into a well-shaped and highly polished trowel; another was forged into a hatchet. Sections cut through the knuckles showed a remarkably solid structure. The variety of steel castings shown was very considerable, and included crossheads, crankshafts, gear wheels, cases for electric street car motors and a face plate for a large lathe some 4 ft. in diameter.

In comparing the work of American steel founders with the steel castings made by foreign firms which were on exhibition the most noticeable difference is that the American castings had a rougher surface, a defect which is usually of small importance, however, as it does not indicate any unevenness or lack of solidity in the metal. It is quite true that American steel founders cannot yet equal the work turned out by the best European firms. They have made marvelous advancement, however, during the past few years, and improvement in the product is doubtless destined to go hand in hand with increase in its use, in this as in other industries.

NEW WORKS OF THE BUCYRUS STEAM SHOVEL & DREDGE CO.

Manufacturing establishments are frequently operated at a disadvantage, owing to the awkward and uneconomical arrangement of the shops and plant. This is due to the original plant having been designed without reference to future extensions, and the additional facilities demanded by increased business have, therefore, necessitated the enlargement of the works from time to time in the best way possible, resulting in a patchwork and inconvenient arrangement. In many cases the resulting inconvenience and expense and the continued increase of business has led to the construction of entirely new works, in planning which the probability of still further enlargement is generally kept in view, so as to obtain to the utmost the economy and convenience due to better facilities and a systematic arrangement of plant. An instance of this character is afforded by the Bucyrus Steam Shovel & Dredge Co., which, as noted in our issue of May 18, 1893, has established new works at South Milwaukee, Wis.

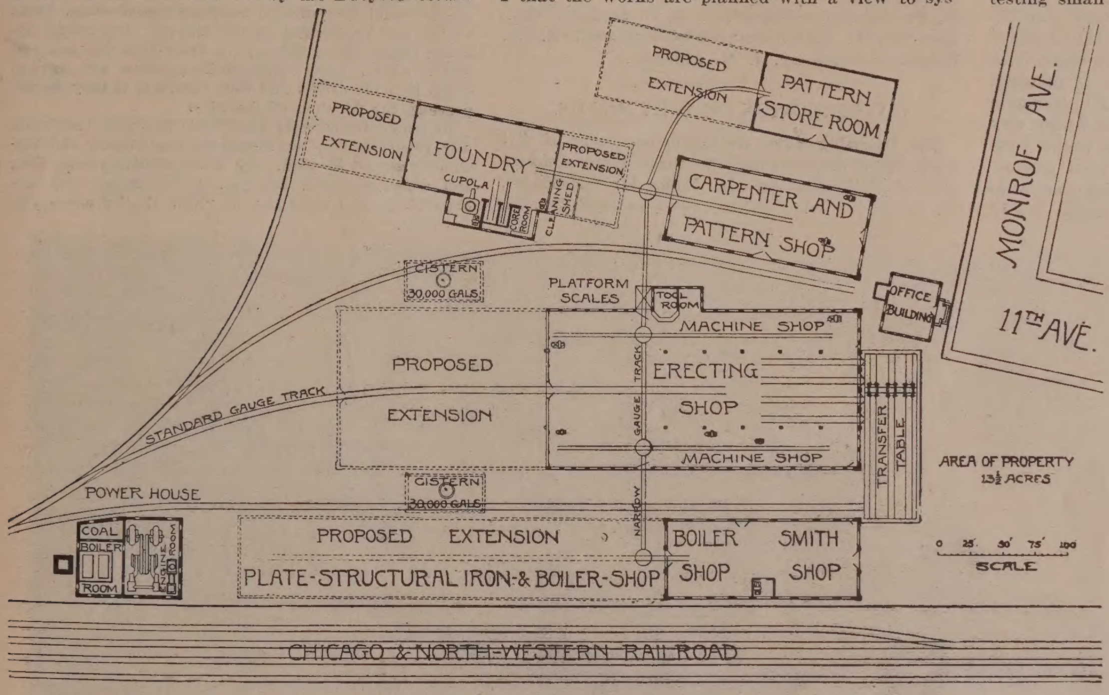


FIG. 1. PLAN OF NEW WORKS OF BUCYRUS STEAM SHOVEL & DREDGE CO.; SOUTH MILWAUKEE, WIS.

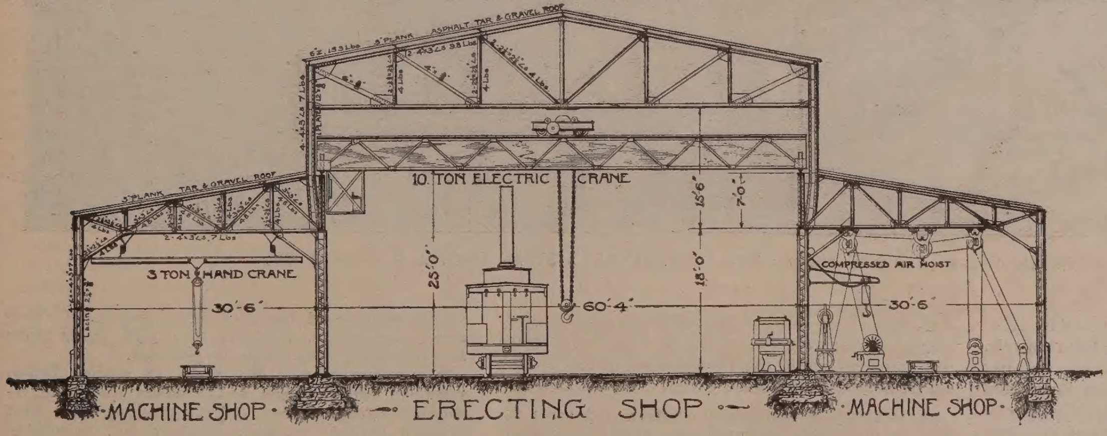


FIG. 2. CROSS SECTION OF MACHINE AND ERECTING SHOP.

This company was established at Bucyrus, O., about ten years ago, and its business and plant grew and increased until the ground on which the works were built became so crowded that a new establishment became necessary for the carrying on and development of the business, and the company finally decided to remove to South Milwaukee, Wis., and build more extensive and complete works. The town is a new one, on the line of the Chicago & Northwestern Ry., about ten miles south of Milwaukee, Wis. The ground occupied comprises 15 acres, including the main establishment and the shipyard, the latter being located on the harbor on the lake shore, three-quarters of a mile distant, where a private and commodious harbor is secured, with ample dock facilities. The shipyard is connected with the main works by a belt line railway. The general plan of the works is given in Fig. 1. and a cross-section of the machine and erecting shops in Fig. 2. The buildings are of yellow brick, with steel roof trusses, and have ample skylight and window area. The several buildings are as follows: three-story office building, 40 × 60 ft.; main building, 120 × 240 ft., with Yale & Towne overhead electric traveling crane running the entire length; smith shop; plate and structural iron shop; foundry, with overhead traveling electric crane of 20,000 lbs. capacity; pattern shop; carpenter and wood-working shop; pattern store house; general store house; power house. It will be seen by Fig. 1 that the works are planned with a view to systematic extension so that their capacity can be more than doubled as future requirements may demand. When thus extended the general plan will be complete and systematic, avoiding the defects which, as already noted, are manifest in many large establishments which are the result of irregular growth. A complete system of standard gage tracks connects all the buildings with the Chicago & Northwestern Ry. tracks, and there is also a narrow gage track for hand trucks, as indicated on the plan, while a transfer table provides access to the construction tracks in the end of the main building.

With the exception of the offices, all the buildings have a ground floor only, there being no galleries. As shown by the cross-section, Fig. 2, the main building is 120 ft. wide, with one central span of 60 ft., and two side spans of 30 ft. each. One of these side spans is used as a machine shop for the lighter tools, and the heavy tools are placed along the edge of the central floor, so as to be served by the overhead traveling crane. The central floor is used for erection purposes. The machine tools are by various makers. The smaller machine tools in yhich the work to be lifted is beyond hand power are served by compressed air hoists suspended from light jib cranes attached to the walls or to the columns of the building. Compressed air is used for the foundry hoists to the cupola platform, an air cylinder having a tubular plunger being sunk in the ground and operating the elevator platform by direct lifting. The same power is also used for blowing out cylinder castings, and for testing small machines in the erecting shop. The compressed air is furnished by a duplex air pump of the New York Brake Co.'s type, as used on locomotives. This is placed in the engine-room and a receiver is kept charged at all times to the requisite pressure. There is no accumulator, and the apparatus is entirely automatic in its action. The buildings are heated by the Sturtevant hot blast ventilating system. The office building has the business offices and those of the general manager, superintendent and secretary on the ground floor. The whole of the second floor is devoted to the chief engineer's office, and the drawing office, which has accommodation for 14 draftsmen.

Electricity furnishes the power for the entire plant, and the reasons for adopting this are given as follows: 1, it permits of complete isolation of the boiler and power plant from the shops: 2, it permits the ready and convenient distribution of any desired amount of power to any desired place and at any desired speed; 3, it avoids the wear and tear and loss of power on machines that are used occasionally or intermittently; and, 4, it lends itself to a variety of subsidiary purposes, such as lighting, welding, traveling cranes, portable drills, etc. The blacksmith shop and foundry have each a Sturtevant blower mounted on the shaft of an electric motor. The water supply is furnished by an electric centrifugal pump, the water being conveyed 2,000 ft. through a 2-in. pipe, with a lift of 50 ft. The current is generated by two multipolar generators of 150 HP. each (one of which is in reserve), driven by a Corliss engine. The larger motors and generators are of the slow speed type, so that connection can be made from the motor direct to the line shaft with one belt. The power is distributed from a central power house to the various localities where power is required as follows:

	Motors.	Horse power.
Machine shop	2	15
Boiler shop	2	5
Pattern shop	2	5
Smith shop blower..	1	15
Cupola blower........	1	15
Casting shop..........	1	5
Foundry crane........	3	4 to 12
Erecting shop crane..	3	5 to 15
Totals..............	15	166

The leading specialties of the work executed by this company are as follows: Steam shovels, light and heavy dredging machinery railway and locomotive cranes and wrecking cars, and placer mining machinery for the Bucyrus amalgamator system. Under these headings are included a great variety of auxiliary appliances and machines connected with similar work, such as centrifugal pumps, ballast unloaders, pile-driving machinery and machinery for public works. The extent of the work necessitates a very complete system of records. The placer mining machinery consists of a small bucket dredge or excavator mounted on the front end of a frame and delivering the earth or gravel into an amalgamator, which, with boiler and engine, is mounted on the same frame. Such a plant is intended for work in gold-bearing gravel, where hydraulic mining is prohibited or impracticable. The excavating work ranges from the lightest sectional steam shovel, capable of being transported by sections on a mule's back, to the largest seagoing dredge of 10,000 cu. yds. capacity. The dredges already built represent over 20 sizes, and include some of the most powerful machines of this class in the world. Among special machines may be mentioned the traveling bucket dredge used by the San Francisco Bridge Co. for cutting irrigation canals, which was illustrated and described in our issue of May 16, 1891. Fig. 3 shows one of the Bucyrus steam shovels at work in a deep cut, and illustrates the character of material that is sometimes met with. The bank in this case was over 100 ft. high, and consisted of heavy clay and large boulders, and at times it would cave down. The machine was on more than one occasion completely buried, but suffered no material injury. This machine has two cylinders, 8 × 12 ins., and a dipper of 1¾ cu. yds. capacity. The company has manufactured nearly 200 steam shovels, varying in capacity from 200 to 3,000 cu. yds. per ten hours. One of these machines was illustrated in our issue of April 27, 1893. In Fig. 4 is shown a dipper dredge which is said to be one of the most complete and powerful machines of its kind ever built. It is the property of the Harbor Commissioners of Montreal, and is capable of working in shale rock and boulders at a depth of 40 ft. The dipper is of 4½ cu. yds. capacity. The main hoisting engines have two cylinders 16 × 18 ins., and are triple geared. The forward spuds are of Douglas fir, brought from the Pacific coast. They are 36 × 36 ins., and 60 ft. long, in one piece, requiring very heavy hoisting and holding machinery, and are operated by wire ropes in such a manner that the entire power of the main engines can be employed to "pin up" the dredge. One of the company's small floating dipper dredges is used by a fishing club, in Ohio, for deepening and making trout holes in a trout stream. A large dredge of the bucket or ladder type, with rubber belt conveyors, was built by this company for filling the Lake Pontchartrain trestle of the New Orleans & Northeastern R. R., as described and illustrated in our issue of Aug. 4, 1892.

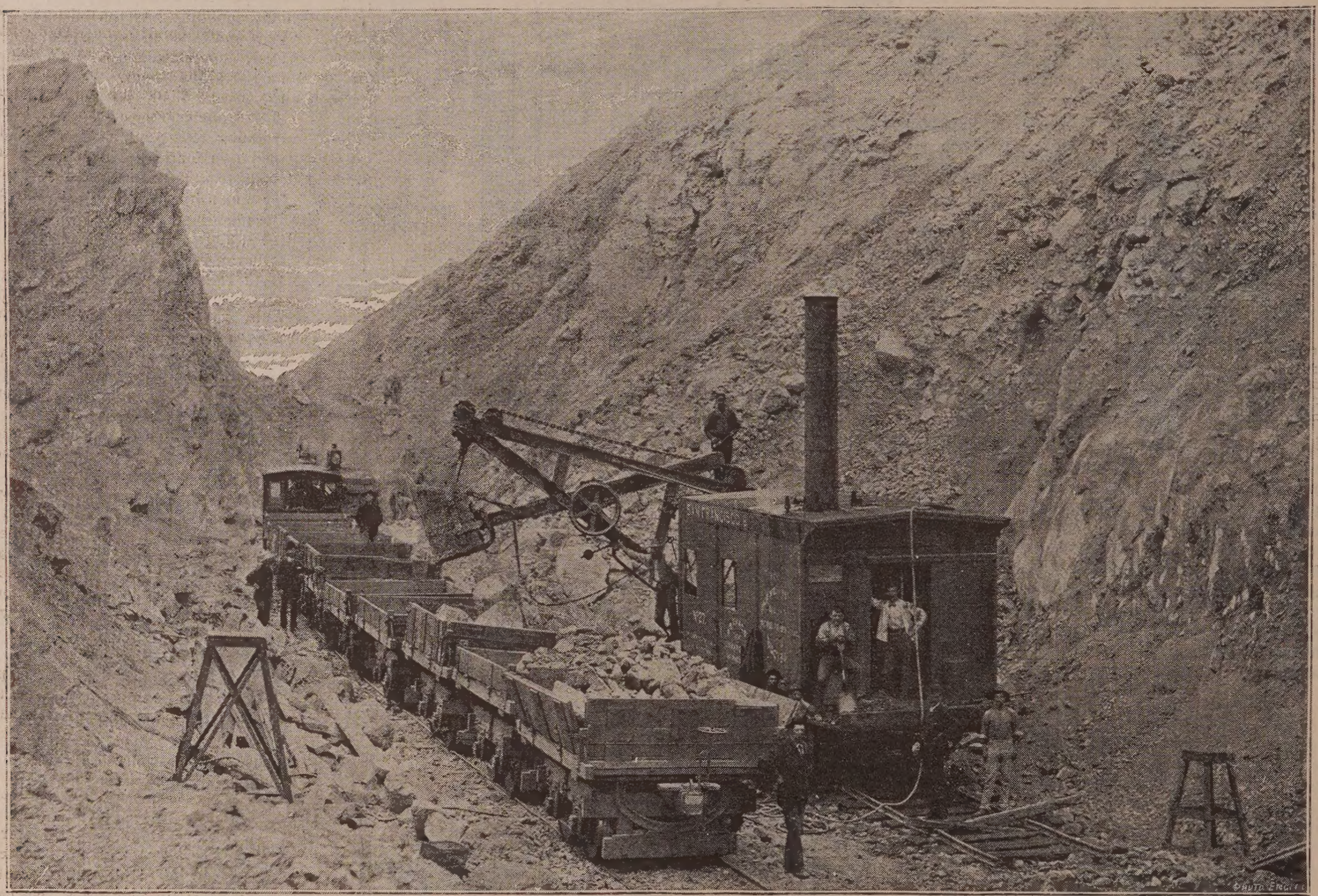


FIG. 3 STEAM SHOVEL IN RAILWAY WORK. BUILDERS, BUCYRUS STEAM SHOVEL & DREDGE CO.

The South Milwaukee works are now in regular operation on dredge and other orders, and much interest is being shown in the special placer mining machines above referred to. The officers of the company are as follows: President, Wm. Hamilton Harris; Vice-President and Treasurer, H. P. Eells; Superintendent, A. B. Stetson; Manager, W. B. Crittenden; Chief Engineer, A. W. Robinson; Secretary, J. M. Millman.

CONSTRUCTION OF DIRT ROADS.

The following notes on the construction of dirt roads were prepared for the State Road Convention of California, by Mr. Julius H. Striedinger, M. Am. Soc. C. E., and Mr. Otto von Geldern, M. Am. Soc. C. E. They were published as part of an extended and valuable series of notes on country road construction in the Transactions of the Technical Society of the Pacific Coast, Vol. X., No. 9:

> About 75½% of the country roads in California are dirt roads. Their extraordinary widths necessitate particular care as to proper drainage, without which the loamy reaches of our roadways soon turn into quagmires during the rainy season. It is well to observe here that with wet or clayey roadways surface drainage alone is not sufficient. Without under-drainage the crown of such roadways will only dry by the slow process of evaporation, during which time the topping becomes more and more rutted by the passing traffic.
>
> A subdrain in such soils will not prove efficient for more than about 12 ft. on each side. Hence two lines of longitudinal subdrains are needed on those parts of our California country roads that pass through wet places, low lying lands or clayey soils. As said before, unglazed round tiles, about 3 ins. in diameter, and, under certain conditions, jointed with loose collars, are most suitable for subdrains. The bottom of the tiles should be laid both to the proper grade and below the frost line, after which the tile trench is filled up to subgrade with clean gravel, small field stones, road metal or broken bricks. The cross drains are also made of unglazed tiles, with the exception of their outlet sections, which should consist of vitrified culvert pipes. Regular branch pipes should connect the longitudinal and cross tiles.
>
> On level reaches the lateral roadway slopes for surface drainage should not be less than 1 on 24; and side ditches should be provided, if necessary, as previously indicated. Finally, a rapid discharge of the side ditches, if required, through adjacent lands, is of the utmost importance to roadway preservation. Trees should not be allowed on the sides of dirt roads, because they impede the drying actions of the sun and wind. Again, their water-seeking roots are apt to creep into the drains and thus obstruct, if they do not prevent, the function of the tiles.
>
> To economically build and repair our wide California dirt roads, modern earth-moving implements and machinery should be used. We mean grading plows, drag and wheel scrapers, harrows, road-levelers, road machines, Western elevating, or "New Era" graders, and wagon loaders and improved dump wagons. Furthermore, road rollers, windmills or pumps, water tanks and sprinkling carts should be provided.
>
> In constructing new dirt roads, all stumps, brush, vegetable matter, rocks and boulders should be removed from the surface, and the resulting holes filled in with suitable material, carefully and thoroughly tamped or rolled, before the road embankment is commenced. No perishable material should be used in forming the permanent embankment. Wherever the subgrade soil is found unsuitable, it should be removed and replaced with good material, rolled to a bearing. The roadbed having been brought to the required grade and crown, should be rolled several times to compact the surface. All inequalities discovered during the rolling should be leveled up and rerolled. On the prepared subgrade the earth should be spread, harrowed if necessary, and then rolled to a bearing by passing the unballasted road roller a number of times over every portion of the surface of the section. In level countries and with narrow roads, enough material may be excavated to raise the roadway above the subgrade, in forming the side ditches by means of road machines. If not, the required earth should be obtained by widening the side excavations, or from cuttings on the line of the new roadway, or from

borrow pits close by; elevating graders and modern dumping wagons being preferably used for this purpose. When the earth is brought up to the final height, it is again harrowed; then trimmed by means of road levelers or road machines, and ultimately rolled to a solid and smooth surface with road rollers, gradually increased in weight by the addition of ballast.

No filling should be brought up in layers exceeding 9 ins. in depth. During the rolling, sprinkling should be attended to wherever the character of the soil requires such aid. The cross-section of the roadway must be maintained during the last rolling stage by the addition of earth as needed. On clay soils, a layer of sand, gravel or ashes spread on the roadway will prevent the sticking of the clay to the roller. As previously explained, the finishing touches to the road surface should be given by the heaviest rollers at hand.

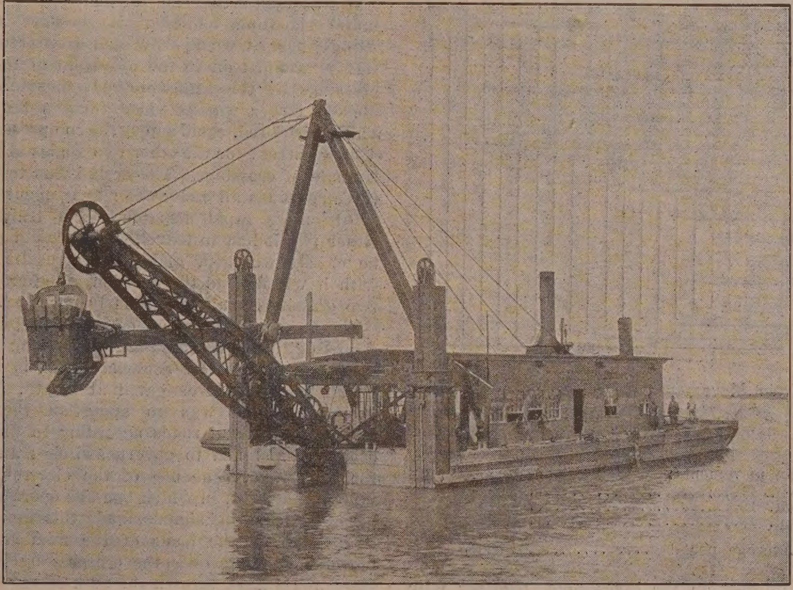


FIG. 4. DIPPER DREDGE, MONTREAL HARBOR COMMISSIONERS.

Before the earth road is opened to the traffic, the side ditches should be cleaned and left with the drain tiling in good working order. Earth-moving implements and road machines are manufactured by the Western Wheeled Scraper Co.; the F. Austin Manufacturing Co.; the American Road Machine Co.; Montgomery, Ward & Co.; San Jose Foundry, etc.

Dirt roads can be improved temporarily, when wet, by layers of brush closely packed and covered with pit gravel. Since wet sand topping offers less tractive resistance than dry sand, sandy roads should not be drained. Such roads may be improved by a 6-in. layer of good clay. A topping of dry reed or marsh grass, etc., improves the surface of sandy roads, and maintains this condition for some time. About 4.7% of roadways in California are sand roads. On clayey roadways, a layer of sand acts beneficially, and all dirt roads are greaty improved by road metal, furnace slag or gravel coatings.

Dirt roads are readily repaired by a judicious use of road machines and road rollers. Plows and scoop scrapers should not be used for this purpose. These repairs should be attended to particularly in the spring of the year, and whenever the roadway becomes rutted subsequently. It is best to commence by lightly scraping at the side ditches, and operating toward the middle of the roadway; following the work up and finishing it with the heaviest road rollers. Holes which are not thus filled should be leveled up with gravel, hogging or other suitable material, and then, well compacted with rollers. If possible, these repairs should be executed during damp weather, or, at least, after a good road sprinkling. The average cost of the better California country road is $800 per mile, the price varying between $400 and $2,000.

On swampy ground, where the expedients mentioned above are not sufficient or applicable, a suitable log or corduroy road may answer. To this end notched cross logs are placed upon good and solid stringers that are laid along the roadbed laterally. The former are again secured near each end by a longitudinal tie, covering them and tree-nailed down. The cross logs are covered with brush or marsh hay, which receives a layer of the best dirt available. Less comfortable to drive upon are such roads where all the sticks are laid lengthwise. Roads built of fascines, covered with good earth, will last, when kept damp, from two to three years. Of course these roads can only be built in localities where there is plenty of wood. About 3% of roadways in California belong to this class.

A COMPLICATED SYSTEM OF RAILWAY TRACKS.

(With inset.)

We show on our inset sheet this week a detailed map of the railway tracks which are included in a space of less than ⅓ sq. mile in the city of Chicago and only a mile and a half from the business center. Perhaps there may be other places in this country or in the world where a more complicated tangle of railway tracks in more constant use is comprehended in a similar space; but we do not know where they are. One crossing only of this maze of tracks, that at Stewart Ave. and Twenty-first St., has been equipped with an interlocking switch and signal plant. The work was done during the past year by the Union Switch & Signal Co. under direction of Mr. E. L. Corthell, Consulting Engineer for the railway companies principally interested. In our issue of Sept. 22, 1892, we illustrated the proposed arrangement of signals at this crossing, and gave some description of it. We are now enabled to illustrate the completed work and give a fuller account of its character.

The Chicago, Madison & Northern R. R. was built to bring the western lines of the Illinois Central system into Chicago. In obtaining its entrance to the city it seemed to have struck a Gibraltar, when it found its tracks stopped at Stewart Ave. and Grove St., by the lines of the Pennsylvania company, and those of the Chicago & Western Indiana road, running to Dearborn St. station, with its six tenants, viz.: Chicago & Grand Trunk, Wabash New York, Lake Erie & Western, Louisville, New Albany & Chicago, Chicago & Eastern Illinois and the Atchison, Topeka & Santa Fe. At this same point the Chicago & Alton makes a junction with the Pittsburg, Fort Wayne & Chicago (Pennsylvania Co.) to reach the Union Depot. Another party jointly interested with the Illinois Central in the accomplishment of a crossing was the Atchison, Topeka & Santa Fe, thus making the agreement of five determined parties necessary before a crossing could be put down.

The tonnage passing this point was already more than that passing between the Mediterranean and the Atlantic; and the roads on the ground contended that there was neither space nor spare time between trains to get another road over. For two years Mr. E. L. Corthell, as Consulting Engineer for the Chicago, Madison & Northern R. R., and Mr. J. F. Wallace, his associate on the work, negotiated with the several companies regarding the manner of crossing. An agreement was finally reached by which the Chicago, Madison & Northern R. R. was to relocate and move all the lines and crossings then down, spreading and deflecting tracks sufficiently to admit its getting over with two additional tracks of its own. Another condition was that the Chicago, Madison & Northern should have installed the most perfect system of interlocking applicable to such a complex crossing, so that train movements would be rendered as safe and expeditious as possible. The plan embodied the working of 40 single switches, 22 double-slip switches, with movable crossing points, and 86 signals. To have handled all these parts, together with the accompanying locks, detector bars, etc., on an ordinary lever machine, using the English practice of connecting parts, would have required one with 275 levers. Such a machine, it was considered, would be inadequate to the requirements of the crossing, besides requiring too much time for its manipulation, and being exceedingly expensive to operate. A 275-lever machine would require a constant attendance of probably not less than 12 men, which, by dividing the day into three parts, would mean 36 men, besides the repairmen and train directors; 36 men at $50 a month each would equal $1,800 per month, or, $21,600 per year, which is 6% on $360,000. Thus, the amount by which the wages of the men required for the manual plant exceed those paid the men required by the pneumatic plant would soon equal the entire cost of the manual plant and in a somewhat longer period the entire cost of the pneumatic plant. It is also claimed that the deterioration of a manual interlocking plant is much more rapid than that of a power-operated plant.

The Westinghouse electro-pneumatic system as constructed by the Union Switch & Signal Co., was selected as the system from which the most satisfactory results could be hoped for, and a contract was made with that company. After more than a year's work on installation, the complete plant was put in service on Aug. 6, 1893, without a hitch of any kind, and it is now possible to form some judgment of the efficiency of the system.

That there should be no possibility of a block to the freight or passenger traffic of the ten roads sending their regular business over this point, occurring through a failure of any part of the power supply, all of its principal parts were furnished in duplicate, as follows: Two 60-in. tubular boilers; feed pump and injector; two Norwalk air compressors with 14 × 16-in. cylinders; two 25-HP. Westinghouse engines; two 110-volt Westinghouse dynamos of 150 lights each; storage battery, with capacity for 36 hours' run. The signal lights of the system are 16 c. p. incandescent electric lamps. In addition to the electric lamp, each lantern is provided with an ordinary oil lamp, kept filled and ready to light, should occasion require. The main air pipe leading from the compressor is 3 ins. diameter, and from this the branch lines are led to the various switches and signal cylinders, the air being maintained under a pressure of 80 lbs. The electric current for actuating the air valve at the switch or signal is taken from a 12-cell storage battery, 5 cells being used on single switches and signals, and 7 cells on double slip switches. There are three sets of similar batteries, two being charged while one is in use. One battery is switched out of service every 12 hours, allowing 24 hours for recharging each set. The length of time that a battery can remain in service without recharging is dependent upon the amount of work being done at the crossing.

A 50-volt dynamo driven by a 4-HP. Case engine, running continuously, is used for charging the cells; and at night the large dynamo used for lamp lighting can be utilized for the same purpose if desired. If an entire failure of the battery should occur, the small dynamo can be switched directly into the operating circuit.

From the signal tower, placed on a bridge spanning four of the tracks of the Western Indiana road, the train director has a clear view in all directions, and is enabled to handle trains with the greatest dispatch. His helper, or leverman, stands facing the interlocking machine, and of its 90 keys, 50 for switches and 40 for signals, he moves those required to set any special route or signal which the director may desire.

The dispatch with which a route can be arranged for a train may be illustrated by taking a regular

Santa Fe passenger train running to Dearborn Station. If such a train shows up and all the switches are in normal position, the leverman has to throw 5 movable point frogs, 4 single switches, 5 double-slip switches and give 2 signals. This he does by moving 9 of the levers, and accomplishes the work in 16 seconds. On a manual interlocking machine he would have thrown 35 levers and worked hard to have finished in 70 seconds.

Passenger trains with from five to ten coaches pass a crossing in from 12 to 35 seconds, or they will run the Santa Fe gauntlet in from ¾ to 1¼ minutes. Delays cannot be entirely eliminated, as the five roads acting independently are liable to schedule trains over the crossing at the same time. Only a limited number of time-card freight trains are moved here, the great bulk of the freight being handled in and out by special switching crews. It is a common thing to see these engines with from 30 to 40 cars and occasionally still longer. These long trains cover the crossings of the other lines from about 3 to 3½ minutes, and during that period several passenger trains are liable to crawl up.

Last April, while the crossing was protected by 16 flagmen and switch tenders, working on twelve-hour shifts, a record was taken for 25 days, 8 hours per day, to determine the average delays. Taking the first 12 days of that record and comparing them with 12 days recently noted under the interlocking signals, it shows that when trains were moved over the crossing by flagmen and the switches were moved by hand the total delays to trains averaged 61 minutes per day of 8 hours. Under the interlocking system the average total delays to trains averaged only 23 minutes in 8 hours. It is to be noted that this record was made for the interlocking when the World's Fair business was crowding the several roads to their full limit. The passenger trains were then very long and were running in from 2 to 17 sections.

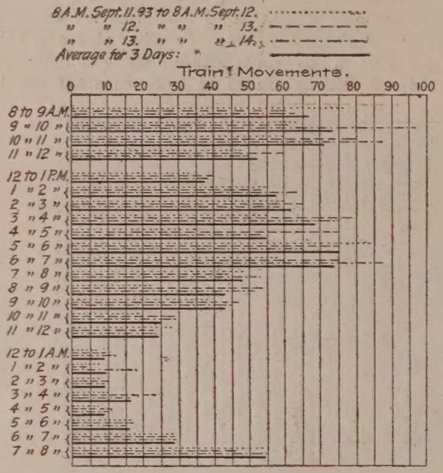
The greatest cause of delays seems to occur to and through the switching crews, making transfers of freight between the several roads. These crews are frequently from foreign roads and are unfamiliar with the track and signals and slow to move. Annunciators are located at the approach to the crossing on each road, so that if any irregular movement is to be made, the train crew can, by a push button, tell the train director what is desired. Telephone communication is also provided from the tower to the yardmaster of the Santa Fe road, and to the head of the Western Indiana coach yard, at Nineteeth St., thus facilitating movements from both localities.

Signals for the Ft. Wayne and the Alton roads are located north of the drawbridge over the Chicago River. To operate these, an air pipe is carried under the river, the pipe being buried to escape damage from passing vessels. All signals north or south of the crossing carrying trains over the drawbridge are locked in connection with the bridge. The act of raising the rails to open the draw locks the signals at danger. By reference to the map on our inset sheet it will be seen that the Western Indiana road has a yard north and a yard south of the crossing. All the switching for these yards has to be done directly across the other lines. The position of these yards rendered the introduction of derails into the system very objectionable to the Chicago & Western Indiana, as their yards would, with derails placed far enough from the crossing to give protection, have been rendered almost useless. The derails were, therefore, omitted, and hence absolute safety from collisions can only be secured by strict observance of signals by train crews.

In September a record was taken for three days to show the actual number of train movements made during each hour. The results are shown graphically in the accompanying diagram.

The average for three days gave 1,031 movements in 24 hours, or 43 per hour. For the 12 hours between 8 a. m. and 8 p. m. the average was 745, or 62 per hour. There were 7 hours in the 24 in each of which the number of train movements averaged over 60 per hour or more than one a minute. The maximum number recorded for any one hour on any day was 96, during the hour from 9 to 10 a. m. In July, 1892, a count showed 981 train movements in 24 hours.

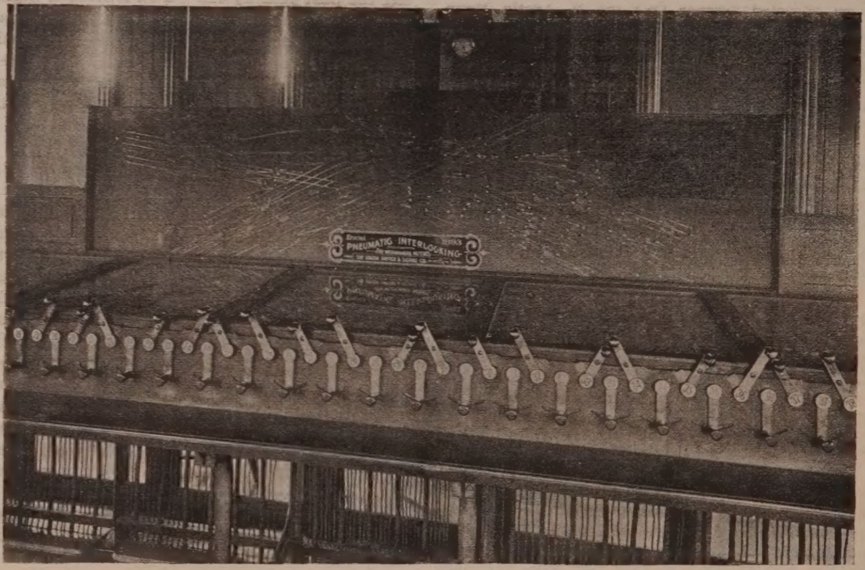
The force regularly employed to operate the plant is at present 1 superintendent, 3 train directors, 8 hours each; 3 levermen, 8 hours each; 2 engineers, 12 hours each; 2 firemen, 12 hours each: 2 repair men, 12 hours each, and a lamp man; total, 14 men. The pay of these men is considerably more than that of the 16 flagmen and switch tenders, formerly stationed on the ground. Added to this is the expense of the power plant, consuming between four and five tons of slack coal per day, and the interest on the investment, together with the maintenance. All this makes a heavy charge, for which a material saving in time and increase in safety must be shown to justify the outlay. The saving of time is particularly noticeable in the movement and switching of freight trains, which, while difficult to estimate in dollars, is highly appreciated by the several roads. The immunity from collisions which is to be expected from the use of an interlocking plant is something still more difficult to place a money value upon, but is doubtless the most important benefit to be gained by the use of interlocking. In considering the cost of operation of the plant, it should be noted that the services of the superintendent and the engineers and firemen will not require to be duplicated when the other angles of this triangle of crossings are interlocked.



Hourly Train Movements Over Interlocked Crossing at Stewart Ave. and 21st St , Chicago, Sept. 11, 12 and 13, 1893.

Total train movements:

Sept. 11	921
Sept. 12	1,070
Sept. 13	1,101
Average per day	1,030⅔



SWITCH BOARD IN SIGNAL TOWER FOR WESTINGHOUSE ELECTRO-PNEUMATIC INTERLOCKING PLANT.

As seen by the map on our inset sheet, two other crossings, about as complicated as the one which has just been protected by interlocking, are located, one half a mile north and the other about the same distance northeast of the crossing just described. Besides the roads named which use the first crossing, there will be met at the others the Chicago & Northwestern, the Chicago, Burlington & Quincy, the Wisconsin Central, the Lake Shore & Michigan Southern, the Chicago, Rock Island & Pacific and the St. Charles Air Line. The last named road is owned jointly by the Chicago, Burlington & Quincy, Illinois Central, Chicago & Northwestern and Michigan Central. It is the main connecting line in this part of the city between nearly all the railways.

It was hoped that the introduction of the pneumatic signaling installed at Stewart Ave. and Twenty-first St. would show such satisfactory results that it would lead to the operation of these other crossings by the same method; therefore, a surplus of power was provided for the initial plant, which, if desired, could supply the compressed air and electric current for the other two angles of this great triangle of crossings. The design was to bring the three crossings all under one management, and thus secure more rapid dispatch for a train through either two it had to travel. The present plant will be closely watched, and on the results obtained with it will depend the decision whether the other two crossings shall be similarly operated.

The proper basis for an equitable division of the operating expenses of the interlocking plant at Twenty-first St. and Stewart Ave. is a matter which has been investigated at length. The original proposition was to apportion the expense among the several roads according to the number of levers installed to govern switches and signals for each road. The use of the electro-pneumatic system, however, in which one key operates a number of switches and signals, made this impracticable. A division on the basis of the number of train movements made over the crossing by each company would have thrown the bulk of the burden on one company. From a record kept for three consecutive days (see diagram) it was found that on the average the percentage of daily train movements by different companies was as follows: Chicago & Western Indiana, 64%; Pennsylvania Co., 13%; Atchison, Topeka & Santa Fe, 9%; Chicago & Alton, 5%; Transfers, 5%; and Chicago, Madison & Northern, 4%. As some train movements require the use of several times as many switches and signals as others, it was evident that any apportionment based on train movements should take into account the amount of use of the interlocking plant for each train movement. Such an apportionment has been made by Mr. Corthell; but the matter is still under consideration by the parties in interest, and no settlement has yet been reached.

As already stated, in designing the power station it was given extra capacity with a view to its future probable use to operate similar interlocking plants at the two other adjacent crossings. Deducting from the cost of the power station $4,500 due to the extra capacity which was given it on this account, the total cost of the interlocking plant amounts in round figures to $100,000. This includes the cost of installing a complete drainage system for the whole area covered, a task which is now being carried out under no small difficulties.

One looking at the complicated maze of tracks shown on our map must have his curiosity excited as to how the trainmen who are to use this system were instructed in its workings. For this purpose a book of rules was prepared containing a separate map for each company. On this map the tracks operated by the company were shown by much heavier lines than the others, and all the signals governing these tracks were shown in color upon it. By the aid of this map it was an easy matter for an engineer to pick out exactly the signals governing his train. The fact that with the enormously heavy traffic over the crossing the interlocking system was put into use without hitches, accidents or delays is good proof of the success of the plan of instruction adopted.

A question which will doubtless occur to many of our readers is what effect the much discussed matter of track elevation will have on this and similar improvements on Chicago railway property. Of course various revolutionary propositions have been made, looking to the elevation of all tracks within the city limits, no matter where located. As a matter of fact, however, the tracks shown on our map and those extending north from this point to the various terminal passenger stations are principally along the river front and are already so covered by viaducts that they cause no appreciable danger to street travel and most of them are not likely to be disturbed. It is from about this section south and west that the removal of grade crossings is now most urgent, and is being most effectively agitated. Mention should be made, however, of the project of the Chicago Elevated Terminal Co., which is headed by Gen. Jos. T. Torrence, and which proposes an elevated viaduct, with lofty freight warehouses and a system of hydraulic transfers for conveying freight cars from surface to elevated tracks. This scheme when carried out will involve the elevation of the Atchison, Topeka & Santa Fe tracks shown on our map; and it is expected by the Elevated Terminal Co. that the advantages and economy of its terminal will be so great that several of the railways now working at street grade at great delay and expense, will be ready to pay a good rental for the use of the elevated terminal, which would probably not exceed one-third of the cost upon the companies as they are now situated. Other than this elevated project there appears no present prospect of the elevation of the tracks at these crossings.

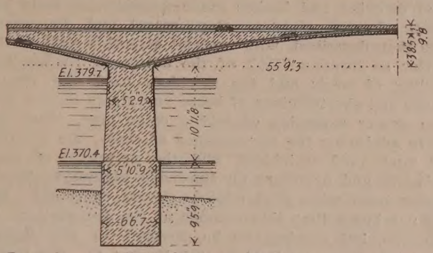
CONCRETE IRON ROADWAY BRIDGE AT NEUHAUSEL, HUNGARY.

A correspondent, Mr. F. von Emperger, calls our attention to the comparative costs of a wooden and a concrete iron roadway bridge erected by the Hungarian government over the River Neutra, near Neuhausel. From Mr. Emperger's letter and from a description of this work in the "Zeitschrift des Oesterreichischen Ingenieur und Architekten Vereines," we give the following description:

The original plans for the bridge called for a wooden structure of twelve spans of 39.4 ft. each, at a cost of about $12,000 complete. But the firm of Wuensch & Co. submitted bids for a bridge made of concrete and iron, for $13,700, and the contract was finally awarded to this firm after some minor changes in the design. This bridge has six arches of 55.8 ft. span, which were erected in four months.

As shown in the accompanying illustrations, light iron members were imbedded in the concrete forming the mass of the structure. What may be called both top and bottom chords were made of angle irons and stiffening plates. All lateral iron members were dispensed with, but at the abutments the 13 chords were anchored to vertical members, as shown, and these were connected by horizontal channel bars, and the horizontal top chord was made continuous. The arches had a span of 55.8 ft. with a rise of 44.5 ins., and were 9.8 ins. thick at the crown and 54.3 ins. thick at the springing line. The total width of the arch, over parapets, was 19.66 ft.

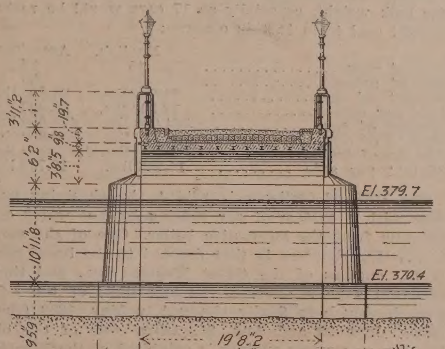
These arches were built on a falsework resting upon pile bents, 8.2 ft. apart. The gravel used for the concrete was taken from the river bed and the average size was about that of a walnut. The concrete for the foundations, or under water portion, was made of one part Portland cement, five parts Roman cement and thirty parts sand and gravel (1 to 5). This concrete was deposited in place by means of a funnel-headed tube. Above water, the concrete was made of one part Portland cement to ten parts of sand and gravel, with proportions of 1 to 8 in the upper parts of the abutments and piers. All concrete was rammed in 8-in. layers and the piers were only built up 20 ins. above the springing line, the remainder of the pier being built up simultaneously with the arches.



Part Longitudinal Section of Concrete and Iron Bridge, Neuhausel, Hungary.

In building the arches the centering was covered with a heavy tarred paper, to prevent warping from the moisture in the concrete. The iron members were then put into position and the concreting began. The concrete for the arches was made of one part Portland cement and six parts of sand and gravel for a layer 10 to 12 ins. thick; concrete 1 to 8 was used for the spandrel portion. The arch concrete was carefully rammed in layers at right angles to the radial lines of the arch, and especial care was taken in ramming the concrete that came below the arched bottom chords. As a rule, one arch was finished in one day, and it was therefore practically monolithic. The spandrels were built with a slight grade toward the pier for the purpose of drainage.

The centering was left undisturbed for 30 days after the last arch had been finished, and striking the centers was commenced at the two center arches. The following table shows the amount of final settlement as compared with the time each arch was supported by its centering:



Cross Section of Concrete and Iron Bridge, Neuhausel, Hungary.

1st arch supported 43 days, settled	0.079 in.
2d arch supported 41 days, settled	0.236 in.
3d arch supported 40 days, settled	0.473 in.
4th arch supported 36 days, settled	0.551 in.
5th arch supported 32 days, settled	0.670 in.
6th arch supported 31 days, settled	0.591 in.

The total amount of concrete used in this bridge was 1,346 cu. yds., and the ironwork weighed 88,180 lbs. At the final testing of the bridge an evenly distributed load of 82 lbs. per sq. ft. of roadway was applied, and later an exceptionally heavy live load was tried. The maximum temporary deflection was 0.138 in., and the maximum set was 0.031 in. As figured, the maximum strain at the crown was 410 lbs. per sq. in.; the maximum tension on the upper member of the iron frame was 2.6 tons per sq. in. under the most unfavorable conditions of load, and the strain on the anchor bolts was 4.07 tons per sq. in. With Portland cement 1 to 6 and allowing 28 days for setting, the strain at the crown is within one-fifth of the ultimate breaking strain.

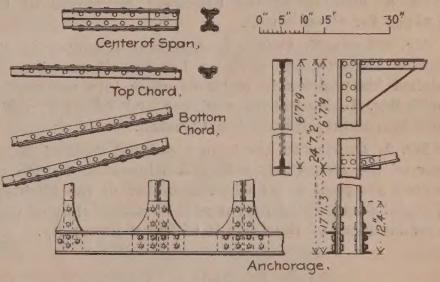
Mr. von Emperger, in commenting on this bridge, contrasts it with the Philadelphia concrete and steel highway bridge, described in Engineering News of Sept. 7. He compares the principal dimensions as follows:

	Philadelphia.	Neuhausel.
Span	25.3 ft.	55.8 ft.
Rise	77 ins.	44.5 ins.
Thickness at crown	27 ins.	10 ins.
Thickness at abutment	75 ins.	54 ins.

Our correspondent goes on to say that the Philadelphia structure was probably economical as compared with stone; and the application of what is a new system in the United States was creditable to Mr. Frick, the engineer; but with more faith and more experience in the materials used, it is evident, by the Hungarian example given, that he could have produced a still cheaper bridge. It must be taken into consideration, however, that good concrete costs more here than in Europe, and its use for monolithic bridge construction, in connection with steel or iron members, has made little progress in the United States. There is evidently a future in this country for work of this description, and the beginning has been made.

WASHING BALLAST ON THE NORTHERN OF FRANCE RAILWAY.

An article in the "Revue generale des Chemins de fer" describes a method adopted for washing ballast on the Northern of France railway. It is assumed to start with that the old theory of the necessary presence of some earth or sand in the ballast, as a binding material, is exploded and that a clean ballast is preferable. The material used on this line was a damp and pasty mixture defying ordinary methods of washing.



Details of Imbedded Iron Work; Concrete and Iron Bridge, Neuhausel, Hungary.

The stuff was extracted by excavators loading into trucks of 8 cu. yds. capacity operated on a track of 1 meter gage. About 12 trucks are loaded in 15 minutes and hauled by a ten-ton engine to the washers and they are there dumped by pairs into hoppers. A pump on the River Serre, of 75,000 gallons per hour capacity, is driven by a 30-HP. engine and the water is forced a distance of 1,050 ft. and lifted 43 ft. above the intake. This water after passing through the washers enters a settling basin with an area of 45,000 sq. yds., and then into a second and a third basin before it finally enters the river again almost clean.

In each washer is a revolving shaft, about 20 ft. long, provided over 16½ ft. of its length with narrow radial blades. This shaft can be adjusted at any desired angle of inclination. The steel blades form a helix with an outside diameter of 2 ft. 4 ins., and each shaft works in a trough of sheet iron with a rounded bottom pierced with ½-in. holes. A space of 2 ins. is left between the ends of the blades and the trough.

The material is fed into hoppers at the low end of the trough and is thoroughly agitated and broken up by the blades; the action of the helical arrangement of blades forces the stones to the high end of the trough which they leave thoroughly clean. The water used in washing is fed from a longitudinal pipe over the washer. The material as excavated contains 40% of sand and clay and the average output of the washer is from 6,300 to 7,300 cu. ft. in 24 hours. It is estimated that the cost does not exceed that of ballast washed in the ordinary fashion.

PERSONALS.

Mr. Wilfrid Little has been appointed Supervisor of Signals on the Eastern Division of the Pennsylvania R. R.

Mr. Edwin A. Hill, has been appointed Receiver's Assistant of the Jacksonville Southern Line, with office at Jacksonville, Ill.

Mr. John C. Chase, M. Am. Soc. C. E., has been elected Superintendent and Engineer of the Clarendon Water-Works Co., Wilmington. N. C.

Mr. D. A. Olin, formerly Assistant General Superintendent of the Southern Division of the Chicago, Milwaukee & St. Paul R. R., died at Racine, Wis., Nov. 6, at the age of 67.

Mr. J. T. Odell, late General Manager of the Baltimore & Ohio R. R., has been appointed Vice-President of the New York & New England R. R., vice Mr. F. H. Prince, resigned.

Cullen M. Stanton, Division Superintendent of the Baltimore & Ohio Southwestern Ry., with headquarters in Springfield, Ill., has tendered his resignation, to take effect Dec. 1.

Mr. Charles C. Brown, Professor of Civil Engineering in Union College, Schenectady, N. Y., has been appointed City Civil Engineer of Indianapolis, Ind., vice Mr. H. A. Mansfield.

Mr. C. S. Mellen, Second Vice-President of the New York, New Haven & Hartford R. R., has been given the direct management of the lines west of New London, Conn., designated as the New Haven system.

Mr. Chauncey B. Ripley, a prominent lawyer of New York, and a commissioner in the Roads Department at the World's Columbian Exposition, died Nov. 12. He was a member of the executive committee of the League for Good Roads.

Mr. George K. Crandall, Assistant Engineer in the Sewer Department, at New London, Conn., has resigned his position in order to enter into partnership with Mr. L. E. Daboll, engineer and surveyor, under the firm name of Daboll & Crandall.

Mr. J. D. Hawks has been appointed General Manager of the Detroit, Bay City & Alpena R. R. He resigned his position as Chief Engineer of the Michigan Central R. R. about a year ago, to accept that of General Manager of the Detroit Citizens' Street Ry.

NEW PUBLICATIONS.

POOR'S DIRECTORY OF RAILWAY OFFICIALS AND MANUAL OF AMERICAN STREET RAILWAYS, 1893. New York: H. V. & H. W. Poor. 8vo; cloth; pp. 650; $3.

This issue of the directory contains, in addition to the usual features familiar to most of our readers from previous issues, a valuable directory of the leading manufacturers of railway appliances. This directory is well classified and indexed by articles, and in its compact form is one of the most useful of which we have knowledge. The value of the volume to railway officials is largely increased by this new feature.

PRODUCTION OF COAL IN 1892.—By E. W. Parker. Abstract from "Mineral Resources of the United States." Pub. doc., 8vo, 290.

This elaborate and complete report shows that the total coal product of the United States (in millions of tons of 2,000 lbs.) has increased as follows:

	1887.	1888.	1889.	1890.	1891.	1892.
Anthracite	39.5	44.0	45.6	46.5	50.7	52.5
Bituminous	90.5	104.7	95.6	111.3	117.9	126.8
Total	130.0	148.7	141.2	157.8	168.6	179.3

The increase is less rapid than one would expect, and yet it is tolerably rapid.

Minute details in regard to this output are given, affording almost any information likely to be wanted, with the proviso that the information to be given is not selected by any uniform rule, except to give what could be obtained.

COUNTRY ROAD CONSTRUCTION—Notes Compiled and Prepared for the State Road Convention of California. By Julius H. Striedinger and Otto von Geldern. Transactions of the Technical Society of the Pacific Coast. Vol. X., No. 9.

We do not usually notice separately the transactions of technical societies, but this particular number contains so much valuable matter on the subject of country road-making, compressed into so small a space, that we make it an exception to our rule. The bulk of the matter is collated from Nessenius, a leading European authority on road-building, but little known here. But the authors made such omissions and additions as the case called for, and quote freely from acknowledged American authorities on this subject. The chief merit of their work lies in the manner in which they have given much and valuable information in 36 8vo pages. Commencing with a brief but satisfactory description of road material, the authors give the best practice in fixing the size of wheels and width of tires for vehicles; the location and gradients of roads, with tables and formulas for greatest admissible and customary grades, the determination of the most advantageous grades, etc. The cross-section of roads is then dealt with, as adopted in France and Holland and advisable for California and other American states. The best curvature for roads and final location is then discussed, with scales of the general and detailed maps, profiles, etc. The next section takes up the subject of constructing new broken stone roads, drainage, side ditches, culverts, bridges, etc.; the choice of stone road covering, vitrified brick roads and the transverse contour of stone roads. The material for broken stone roads, its breaking by hand and machine and broken stone foundations, form another chapter. Furnace slag, gravel and dirt roads are then described, with especial attention paid to the latter as forming 75½% of the California roads. The rolling of roads and the machines used, the advantages and shortcomings of horse and steam rollers, and the proper execution of rolling come next. Then we have advice on the maintenance of roads, the removal of mud, road sprinkling, and the personnel of road laborers and overseers on European highways. These notes teem with good advice, clearly expressed. We do not know that this number of the transactions is on sale, but queries can be directed to the Secretary, Mr. Otto von Geldern, 819 Market St., San Francisco, Cal.

ROUND THE WORKS OF OUR GREAT RAILWAYS. By various authors. London: Edward Arnold. 12mo; pp. 232; illustrated; $1.

This is a reprint of eight popular magazine articles on the locomotive and car works of the leading English railways, with much interesting information in a popular form in regard to the railways, as well as to the construction and types of locomotives and their performance in service. In several cases, however, where the mere number of cars in a train is given, without particulars of weight, grade, etc., the information as to the peformance is not very satisfactory. Still we do not look for such details in popular articles, and certainly the book is a most interesting and readable one. It is profusely illustrated by rather over-reduced and poorly printed half-tones of engines, shops, etc., and there are also some better half-tones of express trains running at high speed. A London & Northwestern Ry. freight engine, with six 5-ft. wheels, all coupled, is said to be capable of hauling trains of 45 loaded coal cars, the weight aggregating 600 gross tons, which, taking the minimum weight of 5 tons for a car of 8 to 10 tons capacity, gives a load of 8.3 tons of coal per car. On the basis of this minimum weight of English car and in ordinary American coal car, we may make the following comparison, which shows the advantages of the latter for bulk weight, especially as 17 cars would be rather a light coal train in this country:

	English.	American.
No. of cars..................	45	17
No. of axles.................	90	68
Weight of car............	11,200 lbs.	25,000 lbs.
Coal per car...............	18,592 lbs.	50,000 lbs.
Weight of cars............	504,000 lbs.	425,000 lbs
Weight of coal............	836 640 lbs.	850,000 lbs.
Weight of train...........	1,340,640 lbs.	1,275,000 lbs.
Weight per axle	14,896 lbs.	18,750 lbs.

The Midland Railway is said to be obtaining success with a system of car heating by hot water circulation from the locomotive boiler. One of the most interesting chapters is that devoted to the broad gage (7 ft.) engines of the Great Western Ry., and their standard gage successors, the last links of the 7-ft. gage having been finally changed in May, 1892 (Eng. News, June 23 and Aug. 25, 1892). One of the old broad gage express engines is exhibited at the World's Columbian Exposition, as noted in our issue of Sept. 28. These engines hauled express trains averaging seven "bogie" cars on four-wheel trucks, weighing 21 tons each, or 147 tons behind the tender. One of the writers, describing a trip made on a Great Western Ry. engine, refers to the men being compelled to stand up all the time, and says that, as might be expected, "such protracted standing makes them subject to various complaints of the leg, whereby they are not infrequently placed temporarily on the sick list." Whether more humane and advanced ideas among English railways will ever lead to the introduction of the more comfortable American cab, with its seats and windows, seems doubtful. The same writer criticises the standard gage six-wheel express engines (with a single leading driving and trailing axle), which have superseded the broad gage engines, as being much less steady and less safe in case of axle breaking than the older engines, which had two axles in front of the driving axle. He does not think, however, that the curves on this line require the use of trucks on the engines.

COMPOUND LOCOMOTIVES.—By Arthur Tannatt Woods, M. Am. Soc. M. E., etc. Second Edition. Revised and Enlarged by David Leonard Barnes, M. Am. Soc. C. E., M. Am. Soc. M. E., etc. Chicago: "The Railway Age and Northwestern Railroader." 8vo; cloth; pp. 330; illustrated; $3.

The first edition of this book was reviewed in our issue of Feb. 28, 1891. In the preface to this edition Mr. Barnes states that the aim has been to add all important developments since the first edition, and to place before the reader the actual construction and practical value of compound locomotives, rather than to describe the plans of various inventors. Extended theoretical discussions and the descriptions of proposed designs have been omitted, but there has been added further consideration of the more important functions of the compound system, and special attention has been given to the development of such safe conclusions about the use of the compound system for locomotives as have been indicated by the results of service. There is an appendix of theoretical discussion on certain important topics, with tables of results in service, etc., and there is also a glossary of terms and a good index, the latter covering 16 pages. As a preliminary to the study of this book we would recommend the perusal of a paper on "The Development of the Compound Locomotive," by A. von Borries, presented before the Mechanical Engineering Section of the International Engineering Congress held at Chicago in August. This paper will give the reader some familiarity with the names and systems mentioned in the book.

The first seven chapters are devoted to a discussion of the general principles, and of the operation of the steam in the cylinders, accompanied by numerous indicator diagrams and tables. Compound engines are divided into two distinct classes: 1, Those having a receiver, into which the high pressure cylinder exhausts and from which the low pressure cylinder takes its steam; 2, those having no receiver, but a "continuous expansion" of the steam. The latter is only used for engines in which both pistons are attached to the same crosshead, as in the Vauclain or Baldwin engines and the Johnstone engines. The ratio of cylinders for two-cylinder compounds is given as averaging between 2 and 2.2 (2.1 being more general in this country), and the ratios for four-cylinder engines as between 2.7 and 3.2, or generally 3 to 1. The limitation of cylinder diameter by the maximum width of the engine has been provided for by Mr. Mallet and Mr. Lapage in designs having two low-pressure cylinders, one above the other, with a crosshead between the piston rods. The next seven chapters are devoted to points to be considered in the design of the engines, such as the receiver capacity, valve gear details, etc., and tables are given of valve movement and port openings of different engines. The author states that the objection to negative lap or inside clearance as causing a waste of steam is not founded on fact and is true only for very low speed engines. He considers increased valve travel and length of ports to give better results than the supplementary or Allan ports, which latter are scarcely applicable to piston valves. In regard to main valves, the author considers that piston valves have been shown to be quite as applicable to locomotive work as to marine work, where they are now so commonly used. It must be remembered, however, that in marine engines the piston valves are vertical, and thus less liable to uneven wear, and are subjected to less severe work than on locomotives.

The different types of compound locomotives are next considered in regard to the application of automatic starting gear, separate exhausts for high-pressure cylinders, intercepting valves, etc. It is pointed out that there is little prospect of or reason for the general introduction of compounds with more than two cranks, as the two-crank compounds have shown such excellent results in practice and have a higher theoretical economy. Consideration of engines having crank shafts may, he says, be dropped, as they have no real or apparent theoretical or practical advantages, but while we recognize the truth of this statement we would call attention to the fact that European practice shows but a slight tendency to the abandonment of the crank axle, either for simple or compound engines. As far as American practice is concerned the consideration of crank axles may be omitted altogether. The author's conclusions are that the four-cylinder type is better in starting trains and on grades, but is not superior in this respect to the two-cylinder type with separate high-pressure exhaust. In discussing the two-cylinder type the author describes the engines on the Mallet system as those which can be operated either simple or compound, at the will of the engineman, as distinguished from those which work as simple engines automatically and only when starting. The Von Borries and Worsdell engines are included in the latter system. The Mallet, or non-automatic, system, is that most generally used in this country, where each builder uses special details and modifications of his own. Credit is rightly given to Mr. Mallet for the first introduction of the compound locomotive as a practical machine in railway service.

In the two concluding chapters the writer takes up the questions of economy and the selection of type and details of design best adapted for a given service. The economy due to compounding largely results from a gain in expansion and the more perfect use of higher steam pressures, and this applies especially for slow freight service on heavy grades and for suburban service. The same high grades of expansion cannot be obtained in a simple engine on account of mechanical difficulties with the valve motion at short cut-off, the very large cylinders (causing the drivers to slip), and the great extent of cylinder condensation due to such an arrangement. The writer states that in fast express and passenger service it is only under the best conditions that much economy can be expected from compounds, though he does not offer any explanation of the fact of the great extent to which engines for this class of service have been built in this country.

The book is well arranged and well printed, and the cuts are in general good. It has been brought well up to date, a commendable feature not always observed in books of this kind, and one which adds very considerably to the value of this particular book. In view of the remarkable and rapid growth of the compound locomotive in this country, this book is of importance in showing clearly and concisely the steps of development and the present status of the question. It is to be regretted that the tables of engines given in the appendix were not summarized as to classes and systems, with some figures of the numbers in use added to such summary. This, however, is a matter of relatively small importance, and the book is one which may be strongly recommended to all engineers who are interested directly or indirectly in the subject of compound locomotives.

TRADE PUBLICATIONS.

ENGINEERING AND ASTRONOMICAL INSTRUMENTS.—Seelig & Kandler, Chicago, Ill. 8vo; pp. 105; illustrated; 50 cts.

This is an illustrated catalogue and price list of field instruments of all kinds, targets, general supplies, drawing instruments, etc. Several pages are devoted to the description of instruments and instructions for caring for them. There is also an article on the stadia, written by Prof. I. O. Baker specially for this catalogue, and a description of the Porro telescope (Eng. News, Nov. 8, 1890).

TIE PLATES. Q. & C. Co., Chicago. 8vo, pp. 5.

This is a set of five half-tone reproductions from photographs of the Servis steel plates and worn wooden ties sent by the company to the Forestry Division's exhibit of steel ties and track appliances at the World's Columbian Exposition. The different forms of plates have been described and illustrated in our columns.

VERTICAL MULTI-CYLINDER ENGINES FOR ELECTRIC SERVICE, Manufactured by the Lake Erie Engineering Works. Field Engineering Co., Eastern representatives. New York City; 4to, pamph.; pp. 30; illustrated.

The vertical engine appears to be rapidly growing in favor with steam users, and especially where power for driving dynamos is wanted. This catalogue gives a brief description of the vertical engines built by the Lake Erie works. Their most important feature is the ability to cut off as late as ¾ stroke when overloaded, thus adapting them to handle the sudden overloads which are of frequent occurrence in street railway work. It is stated that the Lake Erie engine in the power house of the Intramural Ry. developed for short periods a power 2 1-5 times that developed at the most economical point of cut-off. The catalogue contains a number of excellent half-tones showing Lake Erie engines in service.

DRAWING INSTRUMENTS.—Bennett Mfg. Co., Philadelphia, Pa. 8vo; pp. 24.

This catalogue shows the usual line of instruments, many of which are made in aluminum. A bow pen is shown in which the instrument revolves around the rod which forms the handle and pricker point, the point remaining stationary.

ENGINEERS' AND SURVEYORS' INSTRUMENTS.—Buff & Berger, Boston, Mass. 8vo; pp. 150; illustrated; 60 cts.

This is a handbook and illustrated catalogue, the first part consisting of a full description of the various instruments, their use and adjustments, and the second being the catalogue and price list. The first part is written and edited by Mr. C. L. Berger, and contains two papers on stadia measurements by Geo. J. Specht and H. C. Pearsons.

A VISITOR'S DIRECTORY to Cleveland, O., Its Engineering Works and Industries. The Civil Engineers' Club, of Cleveland, 12mo; pp. 83; illustrated.

This very creditable production was prepared by the club named for the use of visitors to Cleveland during the Columbian year. It opens with a historical sketch of the city, and following this the municipal works are taken up and described in sufficient detail for the purpose intended. Then comes the iron industry with a sketch of its methods and the extent of its development illustrated by half-tone engravings of machinery. The large shipbuilding industry of Cleveland consumes considerable space in the directory, and then follow the important private manufactories of various classes.

SURVEYING INSTRUMENTS. The A. Lietz Co., San Francisco, Cal. 8vo, pp. 181; illustrated. 50 cts.

This is a manual of modern surveying instruments and their uses, together with a catalogue and price list. Part 1 contains a description of the company's works. Part 2 deals with the manufacture, uses, adjustments, etc., of instruments. Part 3 contains the following professional papers: "Stadia Surveying or Tachymetry," by Otto von Geldern; "Logarithmic Slide Scale," by Hubert Vischer; "How to Tell a Good Surveying Instrument," by A. Lietz; "To Find the Length of one Minute of Longitude in Any Latitude," by Otto von Geldern; also descriptions of the Goldschmid aneroid and the Saegmuller solar attachment and vertical sighting telescope. Part 4 is the company's illustrated catalogue and price list of instruments.

SOCIETY PROCEEDINGS.

SOUTHWESTERN IRRIGATION CONVENTION.—The first annual meeting of this association occurred at Deming, N. Mex., Nov. 7, about 500 delegates being reported as present from New Mexico, Arizona, Kansas and Texas.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.—At the regular meeting on Nov. 6, Mr. J. W. Howard, of the Barber Asphalt Paving Co., delivered a lecture on "Asphalt; Its Chemistry, Sources and Uses." The substance of his address will be found in the coming report of Mr. F. J. V. Skiff, Chief of the Department of Mines and Mining, World's Columbian Exposition.

C. L. Annan, Secy.

KANSAS IRRIGATION ASSOCIATION.—A meeting will be held at Wichita on Nov. 22 at which the following topics will be discussed: "National Legislation as to Water and Arid Lands"; "State Legislation as to Irrigation Supervision"; "Water Supply—Perennial, Underflow, Interstate, etc."; "Power for Pumping—Steam, Electric, Horse and Wind"; "Effects of Irrigation—Agriculture, Horticulture, Prosperity;" "The Railroads and Their Interest in Irrigation"; "The Government's Interest in Irrigation"; "Results of Government Investigations"; "Irrigation in Southern California." Arrangements are being made for exhibits of irrigation appliances.

E. B. Cowgill, Secretary.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting on Nov. 4 Mr. Alfred Lewis exhibited a section of a 7-in. steel staybolt from a hydraulic riveter, which had broken in the nut about 2½ ins. from the end of the bolt. The static load on the bolt was 450,000 lbs., and at the time the actual load probably did not exceed 600 lbs. It has been found by experiment that when a nut is made to come at the end of a bolt, to obtain uniform stress throughout the bolt, it is not sufficient to make its thickness equal to half the diameter of the bolt, as is generally supposed. The thickness of the nut should be at least equal to the diameter of the bolt. He then explained and illustrated a method of calculating the stress in a bolt, showing that it varied with the square of the diameter, and stated that experiments, which he believed verified the equation given, had been made by the Edge Moor Iron Works, but that he was not yet in possession of the figures.

Mr. John C. Trautwine, Jr., described the largest one of the four single track stone bridges which are being thrown across the narrow valley of the River Pruth, in Galicia.

NEW ENGLAND RAILROAD CLUB.—At the meeting on Nov. 8 the subject discussed was "Permanent Way and Rolling Stock and Their Relation to Each Other." The question of most importance in the discussion was the relation between the gage of wheels and thickness of wheel flanges, and the distance between the guard rail and the frog (see Eng. News, Feb. 2, 1893). Mr. Davidson (Ramapo Iron Works) said that 1¾ ins. had been adopted in New England for the distance between the point and the wing of the frog. West of New York many roads use 2 ins. Much less space could be used were it not for the variation in gage of wheels. The M. C. B. rules allow a variation of ⅞ in. Mr. Turner said he had formerly used a much wider frog throat than he now uses. The narrower the opening can be made and still leave room for the passage of the flange, the better it is. Mr. Blaisdell said that if the variation in wheel gages could be reduced to ¼ in. and the frog throats were reduced to 1½ ins. the frog would wear much longer and the track would ride more smoothly. Mr. Marden said that in mounting wheels in the Fitchburg shops he insisted that the standard gage of 4 ft. 5⅝ ins. between backs of flanges must be strictly adhered to, and no use be made of the allowed ⅛ in. variation each way. The question arises, however, if a 1¾ in. throat is right on a 4 ft. 8½ in. track is it right for the same wheel on a 4 ft. 9 in. track? A large proportion of the Fitchburg track is 4 ft. 9 ins., and they are having some derailments at frogs. It is noticeable that cars from contract shops vary in the gage of their wheels from ¼ in. to ⅜ in. each way. Mr. Coughlin said that thin flanges sometimes caused derailments at frogs. Again, flanges sometimes strike squarely against the frog point. He had known five or six derailments to occur from this cause.

Mr. Lauder thought he had observed less flange wear on wheels under vestibuled cars. The vestibule restrains the rolling and swinging of the cars. He believed that sharp flanges were more likely to occur on straight roads than on crooked roads. Most freight car bodies rest on their side bearings, although they are supposed to be center bearing. When a car body rests on the side bearings it takes an enormous force to swivel the truck. When that car rounds a curve it takes a jump and swings to one side, and when it leaves the curve it comes back only far enough to allow it to run on the rail; it runs on that tangent for miles and miles, and there not being swing enough to bring it back, it grinds on the flange all the way until it comes to another curve and takes a swing the other way. He thought the center bearing car a humbug. A car should have side bearings of such design that the tendency of the load will be to bring the truck back straight with the sills of the car and straight with the track it is to run on.

Mr. Adams brought up the lack of any standard for the thickness of wheel flanges. He had found many wheels with flanges 1½ ins. thick; they were usually from the West. A standard thickness of wheel flange should be at once adopted by the M. C. B. and M. M. associations. At the December meeting the subject for discussion will be "The Locomotive Boiler and Its Atachments."

COMING TECHNICAL MEETINGS.

NGINEERS' CLUB OF PHILADELPHIA.
Nov. 18. Secy., L. F. Rondinella, 1122 Girard St.
SWEDISH ENGINEERS' CLUB.
Nov. 18. Secy., P. Valentine, At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago Secy., John Ericson.
WESTERN RAILWAY CLUB.
Nov. 21. Secy., Clement F. Street, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
Nov. 21. Secy., F. W. Hart, Washington, D. C.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Nov. 21. Secy., R. H. Clark, Pittsburg.
NEW YORK RAILROAD CLUB.
Nov. 23. Annual meeting. Secy., John A. Hill, Temple Court, New York.
DENVER SOCIETY OF CIVIL ENGINEERS.
Nov. 27. Secy., F. E. King, Jacobson Block.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Dec. 1. Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Dec. 1. Secy., O. Von Geldern, 719 Market St., San Francisco.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 4 to 8. Secy., F. R. Hutton, New York.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Dec. 4. Secy., C. L. Annan, City Engineer's Office.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Dec. 5. Secy., W. Halliburton.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Dec. 6. Secy., F. Collingwood, 127 East 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
Dec. 6. Secy., Arthur Thacher, Odd Fellows' Building.
WESTERN SOCIETY OF ENGINEERS.
Dec. 6. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
ENGINEERS' CLUB OF MINNEAPOLIS.
Dec. 7. Secy., E. Nexsen, 504 Kasota Block.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Dec. 7. Secy., C. H. McLeod, Montreal, P. Q.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Dec. 9. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
Dec. 11. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
Dec. 11. Secy., M. F. Schinke, City Hall.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Dec. 12. Secy., F. C. Osborn, Case Library Bldg.
NORTHWEST RAILROAD CLUB.
Dec. 12. Secy., W. D. Crosman. Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Dec. 12. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Dec. 13. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Dec. 13. Secy. F. M Curtis, P. O. Box 1576, Boston.
ENGINEERING ASSOCIATION OF THE SOUTH.
Dec. 14. Secy., W. G. Kirkpatrick, Nashville, Tenn.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Dec. 14. Secy., F. W. Mowbray, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Dec. 15. Secy., D. W. Meeker, St. Paul.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Dec. 15. 201 Washington Building.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Dec. 20. Secy., S. E. Tinkham, 36 Broomfield St.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Dec. 20. Secy., L. J. Carmalt, Roanoke, Va.
ENGINEERS' CLUB OF CINCINNATI.
Dec. 21. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Dec. 21. Secy., Allen Strale, 100 Washington St.
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Jan. 18. Secy., S. A. Charpiot, Macon, Ga.
CENTRAL RAILWAY CLUB.
Jan. 24. Secy., B. W. Spear, Buffalo, N. Y.

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Taken in connection with our editorial on this subject it is interesting to note from the full report of Engineer-in-Chief George W. Melville, that the value of the naval machinery now owned by the United States government and in process of construction is about $24,000,000. This fact in itself points out the enormous importance of steam machinery in our comparatively small navy, and the necessity of having this naval factor under the control of sufficiently numerous, well trained, efficient and properly recognized officers. The completion of the ships now authorized and building will increase the horse power of the propelling machinery of our navy nearly two and a half times its present amount; and as the present engineering staff is now much overworked and must be speedily increased, the time seems propitious for making at least a beginning in a thorough reorganization of this important branch of the service.

The absurdity is also pointed out of putting engineer officers only "in charge" of their divisions, while line and marine officers have "command" of theirs. If ever discipline and the command of men are needed, it is right in the engine-room, in the cases of dire necessity bound to arise in modern naval warfare, where the enemy's ram is to be more feared than its battery. As Mr. Melville says, the officer who can control men in an airtight fire-room, where a bursting steam pipe means death to all in it, and thus successfully aid the captain in carrying out his plan of battle, is quite as brave and important and deserving of just treatment as the officer who controls a gun's crew on deck. Both offices equally demand nerve, ability and the full power to command. The contention that this "command" would interfere with the authority of the commanding officer is absurd, for the latter is not fitted for command in the engine-room should any circumstance place him there, and the admitted command of the line officer over his division is held not to interfere. Look at the problem as we may, in the light of modern naval warfare, the only complete solution seems to be the all-around mechanical training of commanding officers and the abolition of the grade of engineer officer. This practice would be an entire reversal of all naval tradition; but it would not be any more so than is the revolution in naval architecture, armament and plan of battle. Steam to-day practically handles the ship, its guns and its powerful ram; it is an all-important factor in successful warfare now, and its importance grows rapidly, and the commanding officer of the future will of necessity be an engineer. As an engineer is not made in a day, the government that first cuts loose from tradition and corps prejudice and recognizes the coming necessity will be the best equipped in the course of coming events.

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It is apparent from the frequent occurrence of railway accidents charged to oil lamp "explosions" and the like, that there is still a great deal of criminal carelessness on the part of railway purchasing agents or operating officers in regard to the quality of the oil used for lighting cars. Only last week (Nov. 8), for example, in the careless and fatal collision between two passenger trains in the city of Chicago, it is stated:

> When the heavy express engine struck the rear car it pierced half through it, and then sent it into the car ahead. Almost immediately the lamps on the two suburban cars exploded, casting the oil all around and setting the cars on fire.

A holocaust of passengers was avoided only with the greatest difficulty. In the frightful Battle Creek disaster of a month ago it was not avoided, the alleged cause of the fire and consequently of most of the lives lost being the "explosion" of the lamps. Between Oct. 14 and Oct. 17 alone there were four different lamp accidents, or alleged lamp accidents, recorded in the daily press, in two of which the lamp is distinctly said to have "exploded."

In many of these cases we know that the lamps are charged with fires which in fact originated more probably from car stoves, it being now a pretty serious reproach to the management of any road to have fire start from car stoves of any kind. It ought to be regarded as a still more serious one, however, to have fire start from the car lamps, as in nine cases out of ten at least, when this in fact occurs, it will be found to be directly traceable to the use of too low-proof oil. There is always a strong sentiment in favor of such oil among the employees because it burns better and more evenly, and demands less care and attention; but the higher officers should be on their guard against such tendency. There is so little difference in cost of safe and unsafe oil that it seems incredible that any one should be influenced by such a fractional margin, but no doubt ignorant and reckless purchasing agents often are so influenced, and careless managing officers permit them to be so.

The fact that such accidents due to the use of improper qualities of oil seems to be an almost unavoidable incident to the use of oil at all for car lighting is a strong and legitimate argument in favor of not using oil at all in such lighting, especially as so much better light can be obtained from gas. Nevertheless, it still remains true, so far as we know, as was stated in these columns toward the end of 1890 in giving the results of a careful investigation of the whole question of car lighting, that "not a single accident of any moment is on record which has been clearly traced to an origin in proper lamps filled with proper oil." We do not now say, any more than we then said, that no such accidents have in fact occurred. We only say that in every case when such alleged occurrences have come to our knowledge there has been no such accompanying evidence as to establish the fact that the fire was not in fact due to some other cause or to the use of bad oil or bad lamps.

Certainly the rule is that when the lamps start fires at all they start them in ways which practically prove the oil or lamps to have been unfit for use on cars. We confess ourselves puzzled to explain why there should be such general carelessness as to a danger so easily guarded against. Some roads certainly are careful, but others certainly are not. It is a serious objection to the use of oil in any form that this difficulty as to quality exists, and for this and other reasons it will no doubt be conducive to safety, as it certainly will be to public convenience, when oil lamps have disappeared in favor of compressed gas or electricity, the only possible substitutes entitled to favor.

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We give this week some interesting figures respecting the latest and most important trial of the storage battery in electric street car service, which show at least that the storage battery is still a possible competitor of the trolley system, notwithstanding the disastrous commercial failures which it has met at various points. The Waddell-Entz battery, which has been in service about six months on the Second Ave. road, in New York city, is quite a departure from the batteries which have been tried before in street railway service, as it contains no lead nor acid, and it promises to show much better durability and less cost for maintenance than was the case with cells of the older types. It is true that the cost of maintaining the cells is still a large item; but it must be remembered that the storage battery can stand a considerable charge on this account and still meet the trolley system in successful competition, for the cost of erecting and maintaining poles, overhead wires, feeders, and return circuits and of bonding the rails is wiped out at a stroke. In addition the storage battery system promises to generate its power more economically than the trolley system, for the engines and generators work under a uniform load, instead of the very variable load which exists in the ordinary electric railway power station.

The field where the battery can most easily compete with the trolley is on long lines of road with thin traffic, where the first cost of a trolley line is too great to make it commercially feasible, and yet some better motor than horse power is desired. For such lines as this, steam motors, gas motors and compressed air motors are now competing for popular favor, but the drawbacks in connection with each are such that the storage battery stands an excellent chance of winning the race, provided a battery of reasonable durability is made available. The Waddell-Entz batteries weigh about 80 lbs. per HP.-hour of electrical energy stored, or about 25 HP.-hours per ton of battery. In calculating the amount of power to be stored in street car service, it should be remembered that the nominal horse power of the motors is greatly in excess of the average power consumption. The power actually absorbed in propulsion of an electric car will vary, of course, with its weight and load and the grades and curves of the road; but from 2 to 8 HP. is perhaps fairly representative of the average continuous consumption. On this basis it will be seen that the weight of battery necessary to store a reasonable power is by no means excessive when compared with the weight of machinery used in the steam, gas and compressed air systems. The results of further experience with the Waddell-Entz system will certainly be awaited with interest.

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We had something to say last week about the carelessness of men in regard to the form of their applications for engagements, and the harm they do to their own chances thereby. We may, perhaps, usefully add one or two more notes. The carelessness shown by some of the answers in the matter of spelling was notable. Every man should at least realize his own limitations in that respect, and should also realize that little things turn the scale in balancing applications against each other. The discredit which results to him from one or more mispelled words is not so much the direct evidence of a certain lack of training which it affords, but rather the suspicion which it creates of a lack of thoroughness and care in the man's methods of work. The same is true of any neglect to give information which was either distinctly asked for or might reasonably have been foreseen as desirable; or of any lack of reasonable foresight.

For example, one man answers: "I am a graduate of —— years' experience, and write you for a little fuller information as to the vacancy, as I would make no engagement without first knowing just how the work is located." Probably the thought in his mind was that this expression of a proper caution would commend him, and so it would had he kept his caution to himself for later use if he needed it; but his thus refusing in advance to do what had not been asked of him, together with the meaningless information that he was a "graduate," without saying what he was a graduate of, left him open to the suspicion of being a loose and careless reasoner, if nothing else; and thus destroyed his chance even to catch the hare, still less to choose for himself whether to cook it or not.

And finally, several applicants sent in type-written letters instead of answering in their own handwriting. Ordinarily a business letter had better be type-written, but in letters asking for appointments the handwriting is usually regarded as an important indication of character and general training. Applicants who fall back upon the type-writer in such cases, therefore, expose themselves to the reasonable suspicion that they fear a manuscript letter would not be creditable to them, and by so much diminish their chances.

The past week has seen steel rails sold under free competition in the open market at lower prices than have ever before been reached in this country. The agreement among the principal rail mills under which prices have been maintained is a compact of long standing, but it is surprising that it should have endured so long with producing capacity far in excess of consumers' demands and the great steel companies hard-pressed for funds to meet their obligations. The price of steel beams was long kept up by combination, and one standard price of 3.1 cts. per lb. ($69.44 per ton) was exacted. In February, 1892, these prices were cut to 2.3 to 2.8 cts. per lb., and during the sharp competition for orders which has prevailed during the past few months beams have gone down with other steel products, and are now quoted at 1.75 to 2 cts. per lb. in New York, and as low as 1.50 to 1.60 cts. at Pittsburg, for sizes not above 15 ins. The price of rails, however, which had not fluctuated greatly either side of $30 since 1883 (when it averaged $37.75), was kept uniform at $30 per ton from February, 1891, until the opening of 1893, when it was reduced to $29. This latter figure has been steadily maintained all through the trying times of the past summer, in the face of idle mills and receiverships, and only with the appreciable improvement in the metal market of the last week or two has the scramble for orders by the agents of the different mills begun. Just what prices are being made it is difficult to say; but press dispatches quote the Carnegie company as having cut prices to $24 per ton and as having made sales as low as $21.90, while the Boston & Albany is reported to have placed an order for 15,000 tons at $22, with the Maryland Steel Co., the rails being shipped by water to Boston. The Carnegie Co. are alleged to have taken the initiative in cutting on the ground that it can afford to roll rails more cheaply than any one else; but this latter statement is, perhaps, an embellishment, by the reporter, as it is certainly claiming a good deal to allege that the Edgar Thompson plant, if it has any advantage over the fine new plant at Sparrow's Point, or the Illinois Steel Co.'s South Chicago plant, has such an advantage that it can afford to sell at materially lower prices.

The lowest prices for steel rails ever before reached (according to the diagram published in our issue of July 28, 1892) were $28 in July, 1889, and $28.50 in December, 1890; and in 1885 the mean price was $28.50. The actual cost of rail production, and the prices at which rails are likely to be sold, if free competition continues to prevail as in other departments of steel production, has been a matter of much dispute. Mr. Carroll D. Wright, in his report as Commissioner of Labor in 1890, said:

> The department has been positively informed relative to the cost of making steel rails in several of the very largest establishments in the United States, and there is no shadow of a doubt in the mind of the writer that in these establishments the actual cost of standard steel rails is, and has been for some time, within a few cents of $22 per ton at the works.

This was written three years ago, and since that time prices of ore, coke and freights have been reduced, and labor also has during the past few months had to take its share in falling prices. If the above statement is correct, therefore, it is probable that our largest and best equipped rail mills could now turn out rails at a cost of not more than $20 per ton. It is to be remembered, however, that these figures of cost were based on a continuous operation of the works on a large scale. That any such figure can be reached by the mills when working as they now are on hand-to-mouth orders, necessitating frequent changes of rolls, and more or less delays due to following details of differing specifications, seems not at all probable. It is fair to say, moreover, that Mr. Wright's figures of cost do not include interest on the capital invested in the plant. Thus they represent not the price at which production can be carried on allowing a fair return to all parties, but the lowest price at which the manufacturer will keep his mill in operation rather than have it stand idle, with the attendant depreciation, and the loss due to withdrawal from the markets. Such a price cannot in the nature of things be a permanent one, and it does not seem likely, even barring a possible renewal of the rail makers' compact, that the price of rails can go permanently below about $24 to $26 for some time to come, except in times of slack demand. The latest English quotations for steel rails at the mills vary from $18.28 to $18.88; and when freight and handling are added to this cost, the lowest price at which English rails could now be imported into this country, duty free, is about $22.50 if laid down at interior points, and, perhaps, at tidewater. The present duty on steel rails is $13.44 per ton.

THE NAVAL LINE AND STAFF ISSUE.

In his last official report Commodore George W. Melville, Chief of the Bureau of Steam Engineering, makes a strong plea for conferring actual rank upon the steam engineers of the navy, as compared with the present meaningless "relative" rank. Commodore Melville truly says that in the naval battle of the future ships must fight with their engines as well as with their guns; that the ram will be a more dangerous weapon and one more feared than the battery; and that unless the boilers and engines are properly handled, the ship will be a helpless, drifting mass, absolutely at the mercy of an enemy. He clinches his argument by referring to the late "Victoria" disaster and to the fact that the whole engine-room staff of these "non-combatant engineers" stood at their posts and perished to a man.

While all this is true, Commodore Melville, at least in the advance abstract of his report as published, does not make it plain how this reform is to be brought about. A warship, like a nation, must have an acknowledged supreme commander and an established line of succession to that command; otherwise, as in national affairs, confusion and disaster will inevitably follow. As at present organized the "line" officers of the navy hold this succession and are eligible in turn to the supreme command, while the "staff" only hold relative rank and can advance only to the highest grades in distinct professional lines always subordinate to a commanding line officer. This gradation of duties and responsibilities was fixed long ago, when the modern warship was undreamed of, and the actual duties of the few staff officers then required were properly very subordinate to those of the fighting officers proper. Conditions have radically changed now, as far as the fighting machine is concerned, and the powerful and complicated engines and the accompanying machinery and appliances for manipulating heavy guns, handling ammunition, lighting and ventilating the modern warship and doing the hundred and one other things about the ship that require a thoroughly scientific as well as a mechanical training, combine to make the engineer officer one of the most important officers aboard, and his staff and assistants of all grades now usually make up a very heavy percentage of the entire ship's company, stated by Commodore Melville at from 25 to 60%.

The whole present difficulty between the line and the engineering staff seems to arise from a conflict of authority between the line officer who is for the time being officer of the deck, and thus represents the commanding officer, and a staff officer, of perhaps superior relative grade, who is for the time being nominally in command in the engine-room. We say nominally, for it is held that the line officer can command the presence of the staff officer on deck, and if he sees fit change the orders of the staff officer in the engine-room by ordering his men to other duty. Discipline is quite as necessary in the engine-room as upon the quarter-deck, and even more so in an emergency, and the existing practice is evidently not conducive to strict discipline or to peace between two important classes of naval officers. But just how any reform is to be brought about it is very difficult to determine, and suggestions only can be made.

The modern warship is practically an intricate mechanical engine and the day of sails and the clever handling of a warship by sails is practically past forever. The power of a ship now lies in its engines as much as in its guns, and there is no doubt that the commanding officer who thoroughly understands the full capacity and power of all his fighting machinery is the better able to handle his ship in any emergency. At the present time the average engineer officer of the navy is quite as much a gentleman to start with, is quite as brave and is generally more highly educated from a professional standpoint than is the line officer. Why not then bring all officers up to this higher grade and abolish the troublesome staff rank as far as engineer officers are concerned? Up to a certain point both classes of officers receive the same education, and it would seem that the time saved by the practical abolition of sail power could be profitably and properly devoted by all naval officers to a careful study of the steam engine which has supplanted sails. Then all officers would be steam engineers and there would be an end of all existing conflict of authority between two very responsible classes of officers. The gravest difficulty in the way is the extent of the training required to make a thoroughly competent engineer. In other words, it is now easier to turn out a good line officer than a good engineer. But the further training required would be in accord with the advancing tendency of modern naval education, and while some young officers would probably object to passing aft through the greasy engine-room, the generally broader training should be in the end beneficial to the service.

The solution here suggested differs in essential features from that attempted in the English Navy, where the engineer officer is now relatively very poorly paid. A chief engineer there receives a salary of from $1,475 to $2,825 per annum, all extras included, or about the equivalent pay of a navigating lieutenant in the same service. The later effort in England seems to be to reduce the engineering staff as nearly as possible to the grade of skilled mechanics and remove it as far as possible from the gentleman grade of line officers. This practice may answer in a country where traditionally, though not actually, any form of trade is to be dispised and is not deemed fitting employment for a gentleman. But it is certainly not in accord with the education, training and high professional standing of the engineer officers of the United States Navy. Engineers may not be fighting officers in the more strict use of that term on board a warship, but the interest of the service and the duties of their office require that they shall be brave men, ready for any emergency. It is true that they may be and undoubtedly would be brave as skilled mechanics; but there is a certain something in the feeling of rank and in the responsibility of office that always distinguishes the officer from the man in cases of dire emergency, and adds immeasurably to his fighting value. It would thus seem better to combine the duties of the line and engineering staff into one class of officers, rather than to reduce the grade of one to the possible detriment of the other. The first start toward such a plan certainly involves difficulties, but the duties and responsibilities of the two classes seem to be now too intimately united to permit any more satisfactory solution of what will be an ever-increasing source of trouble in the personnel of the United States Navy.

We may see this very clearly if we glance a moment at the past of naval history. In old days, even in the English service, and still more in the French, it was considered as unbecoming and as unnecessary that the fighting officers should be masters of navigation and seamanship as it is now that they should be masters of steam engineering. Every ship carried its navigating officers who were not of the "gentleman" class, while the commanding officers and his chief subordinates were young sprigs of nobility who possessed no other qualifications for their duties than good fighting and commanding qualities, which we may grant them. What was the consequence? The French navy was wiped out, while the English navy (which gave up the practice much earlier than the French) suffered severely in efficiency until the modern rule was adopted, that officers must make themselves good sailors in every sense, as well as good officers, if they wish for promotion. Every navy in the world is now managed on this theory, though doubtless it is often broken in practice to favor individuals.

Are not the conditions precisely the same in nature, to-day, only much more so in degree? Do they not clearly indicate that the naval officer of the future, to be efficient and useful, must be a good mechanical engineer, whatever else he is? The line officer of to-day is as much a mere passenger on his ship as the passenger in a Pullman car. He can "command" her, indeed, because the law invests him with that authority; but he cannot handle her; and what is worse, he does not know enough about her to know whether she is well handled or not. Let some accident disable half a dozen men, more or less, and he and all the rest of his officers and crew would be utterly helpless. They could not even bring the ship into port with safety, still less fight her. On the other hand, in our service at least, a very little training would make the engineering staff as good fighting and commanding officers as they are engineers. That each class of officers does not have the training to fit them for either duty is an absurd handicap on efficiency which only exists because steam power is a thing of yesterday and traditions are powerful in such a service. The navy which first sees the absurdity, and ends it, will be the one to bet on at long odds when it comes to fighting. It is nearly 80 years since there has been a true naval war. When it does come it will teach some sharp and painful lessons.

LETTERS TO THE EDITOR.

THE SOARING POWER OF BIRDS.

Sir: After a careful perusal of the editorial on "The Soaring Power of Birds" in your issue of Oct. 26, I find myself, in common with quite a number of your readers, I presume, quite unable to accept a theory that, in my opinion, does violence to the ordinary principles of mechanics.

We are asked to believe, in effect, that a bird, or in this instance an aeroplane, can, by a merely steering maneuver, greatly increase its relative velocity without any aid from gravity. For example, in the instance already so often cited of a bird in air of 20-mile velocity, the claim is made that the bird's relative velocity of 20 miles per hour attained at the foot of the first inclined plane can be increased to one of 60 miles per hour in the opposite direction by a quick turn involving no propulsive effort. If this can be done in a body of air moving horizontally, why not also in still air, in which case the relative velocity would incidentally be the absolute velocity? We are told, however, that this can only be done in moving air. But since the interaction of bird and air would then be in no wise affected, can we not imagine the moving air containing the bird to be inclosed between the walls of an immense car moving uniformly with the same velocity and in the same direction as this moving air? And yet the (correct) declaration is made near the foot of the first column of the editorial that "motions which are confined to the interior of a moving train" (moving uniformly and rectilineally, is, of course, understood) "are not affected by the motion of the train, but are subject to the same laws as if the train were still." There seems to be some inconsistency here.

In the second column of page 335 I think there are cases of ambiguity in the use of the word velocity; relative is not distinguished from absolute, and vice versa. Near the head of this column the peculiar maneuver adduced is said to consist of a "ricocheting against the air somewhat as a billiard bill does against a cushion" or of a "moving in a curved path as a ship may in water; in each case without any theoretical or large surrender of velocity." With the word "velocity" replaced by "relative velocity" this statement is true; but if absolute velocity is meant, it cannot be true (unless the surrounding medium is still). We are taught in mechanics that the relative velocity of a ball after striking a cushion, even if the cushion is perfectly elastic and is backed up by an infinitely great mass, cannot exceed the relative velocity before the impact. In other words the relative velocity after impact would be no greater than that possessed before, just as in the case of the ball and the semicircular track mentioned in the first column; while the absolute velocity would be quite different from its original value. Any "cushion" that the bird may ricochet against must necessarily be a portion of the moving air around the bird. As to the analogy of the ship, Mr. Wisner has already used the comparison to illustrate the fact of there being no change in relative, but a great change in the absolute, velocity, by reason of the 180° turn (without propulsion), if the ship is in a current.

As to the facts of soaring, it is quite possible that observers have not been able to discriminate properly between acts of propulsion and those of mere steering. I dimly recall a discussion on this point some years ago in the London "Engineer," where I think one correspondent wrote of having actually observed local movements of parts of a wing, the wing not being in motion as a whole. As supporting Mr. Wisner's point that advantage may be taken of various currents of air at different elevations, it may be well to remember that the trade winds are generally accompanied by counter currents in the upper air; also that in some localities currents of air frequently rise vertically.

In the lower part of the second column of page 335 is the opinion "that it is simply impossible that the bird's body should surrender the energy due to motion at 50 to 60 miles per hour as quickly as it is turned to face the wind, for that is practically instantaneous. If it did, in fact, do so, the concussion would kill the bird."

It may be worth while to examine and test this statement. Let us suppose a wind with a southward velocity of 30 miles per hour, and a bird in it with a southward relative velocity of 30 miles per hour (44 ft. per second), i. e., with an absolute southward velocity of 60 miles per hour (88 ft. per second. Let the bird's absolute velocity be entirely surrendered in one third of a second of time by being guided along a semicircular guide or track carried by the moving air (as in the illustration of the first column). The radius of the semicircle will need to be 4.68 ft., that the length of the semicircular path may be described in one-third of a second at a relative speed of 44.00 ft. per second. Also assume the weight of the bird to be 10 lbs. The centrifugal pressure between the bird and the guide will be 130 lbs. (by the rule on page 368 of Trautwine's Pocketbook, using the relative velocity of 44.00 ft. per second) and will be always at right angles to the relative path (neglecting relative drift or "slip"), and hence have no effect on the relative velocity. In this time, then, of one-third of a second, all the initial absolute energy of the bird is surrendered, and at the terminus of this semicircular relative path the bird finds itself 14.7 ft. south of its initial position relatively to the earth (but abreast of it relatively to the moving air) and in absolute rest; its initial absolute energy having been absorbed in the overcoming of that component of the pressure, 130 lbs., which is tangential to the absolute path. This absolute path is a reversed curve, which can be easily drawn by a simple construction. Not raising the question at present as to whether this pressure of 130 lbs. (chiefly against the wings) will kill the bird or not, let us proceed to get some idea of the pressure that would be brought upon the bird if it were possible for it to convert its southward absolute velocity of 88.0 ft. per second into a northward absolute velocity of equal amount, in one-third of a second. If this be done by its following a semicircle fixed relatively to the earth, this semicircle will need a radius of 9.36 ft., if a speed of 88.0 ft. per second enables the bird to describe it in one-third of a second. Computing the centrifugal pressure as before, using now the velocity 88.0 and the radius 9.36 ft., we obtain 260 lbs., double that in the preceding case; and if any smaller time be assigned for the turn a smaller radius must be taken, giving a larger pressure, in inverse ratio. But even if no particular path be assigned for this supposed quick reversal, in direction, of the absolute velocity, the mere circumstance of the reversal's taking place in one-third of a second leads to the following analysis and conclusion: If a change of velocity occurs from 88.0 ft. per second southward to one of 88.0 ft. northward in one-third of a second, i. e., if the total change in northward velocity is 176 velocity-units, or feet per second, and is brought about in one-third of a second, then this change of velocity is at the rate of 528 velocity-units in one second, which rate, or "acceleration," is 16.4 times as great as the acceleration of a falling body (32.2 ft. per second in each second). Consequently the bird would have to be subjected during this change of velocity to a force or pressure the average value of whose north and south component would be 16.4 times the weight of the bird, i. e., 164 lbs. The maximum value of the force itself might be very much greater, according to the form of path. It would appear, then, that for equal times the "concussion" would be much greater in the new theory than in the case of a total surrender of absolute energy.

As to the argument (foot of second column, page 335) that "there is no reason why it (the bird) should (surrender its energy due to motion) than that a ship should surrender its velocity when its rudder is turned so that it sails about in a semicircle instead of going straight ahead," it should be remembered that in this maneuver of the ship Mr. Wisner and myself acknowledge that there is no change in relative velocity, and hence no change in relative energy, while calling attention to the fact that there may be a great change in absolute velocity and therefore in absolute energy. Since, further on in the editorial (foot of the third column, page 335), a parallel with a river steamer is termed "most delusive," why employ the very same parallel in the second column in support of the theory under criticism?

Will not the author of this new theory, in addition to referring to a "peculiar power" of the bird, favor us with a drawing or sketch showing several successive positions of a propellerless, but self-steering aeroplane in the process of increasing its relative velocity, showing clearly its relative path and its absolute path, and how and why the pressures on the aeroplane from the surrounding medium must have such and such directions and values, producing such and such effects in accordance with the laws of ordinary mechanics?

It is doubtless true that this new theory would account for some of the evolutions of soaring; but the very same thing could be said of a theory claiming that a soaring bird could, from time to time, at will, cause the force of gravitation on its own body to be less than the normal. With the present light on the subject I must confess myself unable to reconcile the former of these theories with the ordinary laws of nature any more easily than the latter.

J. P. Church.

Ithaca, N. Y., Oct. 30, 1893.

(Having invited this discussion by the publication of our own article, we think it only fair to give opposing conclusions full opportunity of presentment; but this letter strongly illustrates the truth that in most cases of heated discussions which do not produce conviction, the real ground for the continued discussion lies either in lack of agreement on premises or in misapprehension of an opponent's position. In this case the very first sentence of our correspondent's argument is that he "is asked to believe that a bird or aeroplane can, by merely a steering maneuver, greatly increase its relative velocity without any aid from gravity." As he was not asked to believe anything of the kind, but, on the contrary, was asked to admit that the continuous inter-action of gravity and wind velocity was the sole and necessary source of the soaring bird's propelling energy; it is profitless to continue the discussion as such. There is non-agreement on premises. The two views have been presented and every reader interested enough to do so can take his choice between them. We have received two or three other letters taking much the same position as Professor Church, but it is notable that not one of them comes from any one who makes claim to have studied the action of soaring birds from life and at close quarters, in (to the senses) perfectly uniform winds. To any one who has done so the inadequacy of certain suggestions in the above letter as to alleged "local movements of parts of a wing" and "counter-currents in the upper air" will be very apparent.

One counter-argument only is advanced in the above letter which we perceive to be at once warranted by prior arguments or statements and of inherent strength, viz., that given toward the end of the second paragraph in relation to an "immense car." Our correspondent reasonably asks: "Can we not imagine the moving air containing the bird to be inclosed between the walls of an immense car moving uniformly with the same velocity and in the same direction as this moving air?" The answer is, Yes, we may, provided only we make the car big enough in cross-section and of indefinite length, and give it glass sides so that the bird may see the earth through it or else educate a race of birds specially for such surroundings. In a car, say, 200 ft. square in section and of great length, any soaring bird will without the slightest difficulty move up and down and back and forth forever (or until it gets tired) without touching floor or walls and without exerting any muscular propelling or sustaining effort, with the sole proviso that it must either have an inherited instinct to look out for the end of the car or must not be troubled by encountering any. Nothing can be more certain experimentally than this; for the sole function of the car in this case is to keep the air moving horizontally at a uniform velocity as a substitute for the usual causes for such motion. A flying creature's motion in the contained air space only of such a car and a walking creature's motion on the floor of such or any moving car is governed by very different laws. In the latter case the car floor takes the place of the earth's surface as the body with relation to which motion occurs. In the other case it does not, but is a mere extraneous moving body, having no other relation to the problem in hand than to take the place of the usual forces to cause a great mass of air to move over the earth's surface at right angles to the action of gravity.—Ed.)

THE BIDS FOR THE PROVIDENCE PUMPING ENGINE.

Sir: In reference to the award of contract for the 15,000,000-gallon pump for the city of Providence, on the basis of comparative annual cost plus 4% on invested capital (Eng. News, Oct. 12), I beg leave to make a few remarks: Since all duty calculations are based upon a certain given quantity of work accomplished, it is of great importance that this amount be actually obtained and not merely assumed.

During many years the writer has had almost a daily experience with the duplex system of pumping engines, and has found that they never accomplished what they are supposed to do, as regards capacity. The reason for this is, the fact that such engines, from the absence of a crank, or other positive means of determining the length of the stroke, are set with enough compression to prevent "bumping" against the cylinder heads, should the pressure in either cylinder vary materially from the point at which they are ordinarily supposed to run. This almost invariably results in short running, since any correction of this fault must be by the engineer's or attendant's adjustment of the starting valve or the compression valves on the cylinders. As a general rule I have found that a 48-in. stroke, horizontal, "duplex" pumping engine will run short about ½ in. to 1½ ins. on each end and sometimes even as much as 5 ins. on each end, depending upon the watchfulness of the attendant and the amount of variation of steam and water pressures.

The application of certain substitutes for a flywheel improves the conditions somewhat in this respect; but the evil alluded to is not by any means obviated, as observation proves.

Now, what influence has this evil on the economy of the plant?

First, reduced quantity of water delivered. Second, a consequent pro rata increase of steam used, i. e., full consumed, since the cylinders are filled from the boilers every time, whether the stroke is full or partial. Third, when the air-pump is attached to the main engine, as is usually the case, its stroke is shortened in the same proportion; hence the vacuum is impaired, as, also, experience shows.

During a test of such a pump, when there are watchful attendants in plenty, and everything is worked to its highest tension, the plant will always come up to its guaranteed duty, but it is an exceedingly troublesome task to get the same efficiency throughout the year under the hands of the average machinist.

Since the publication of the statement above alluded to has been received with a great deal of interest, these remarks are submitted as an aid to an impartial consideration of the subject.

Yours truly, E. Y. W.

Phila., Pa., Oct. 28, 1893.

MOVEMENT OF TOWERS DUE TO THE HEAT OF THE SUN.

Sir: I beg leave to take exception to the following extract from the otherwise very interesting paper of Mr. R. C. Grimm on "The Tower of the New City Hall at Philadelphia," read before the American Society of Civil Engineers, an abstract of which was given in Engineering News, Nov. 2.

> An interesting note is added, giving a table showing the horizontal deflections of the masonry tower under the influence of the sun, determined by readings taken three times a day, excepting Sundays, and covering a period of one year; showing also the maximum, minimum and average temperatures each month, taken at a point inside of the tower, 230 ft. below the top. Deflections were measured by a plumb line of thin piano wire 230 ft. long, with a heavy weight suspended at the bottom. The frame rests on a wooden box containing molasses into which the weight is dipped. The maximum measurement in the north and south direction was 9-32 in. and in the east and west direction 5-32 in.

If I understand the meaning of the paper, Mr. Grimm finds that the top of our City Hall tower is wriggling around like a tree-top in a storm, changing its position anywhere from 5 to 9 ins. under the varying effect of the sun's heat. I am aware that it has been fashionable of late years, in consequence of some experiments on the Washington Monument, to find all our high public buildings roaming round in this free and easy style, but it will require some more weighty proof than any so far advanced to convince me of the correctness of any such deductions from plumb line experiments.

I have often seen the plumb line referred to, and you can readily imagine that an arrangement of this sort 230 ft. long, entirely exposed to the strong drafts in the tower and to the disturbance caused by occasional running of the elevator and operating machinery, which is close to the box of molasses, is not a sufficient basis for such conclusions, particularly when the whole affair is most of the time under the charge of the engineman, the fireman and the night watchman. Further, without going into any calculation on the subject, considering the great mass of the tower and the capacity of stone for conducting heat, it is to me simply inconceivable that the effect of any given temperature could be shown by the plumb line until a period of many weeks had elapsed; so that, whatever variation of the kind may exist, a daily variation seems out of the question.

The main reason, however, for doubting the correctness of Mr. Grimm's conclusions is in the fact that the city of Philadelphia has, in a desultory sort of way, been carrying on a triangulation for some years past. The work has been spasmodic in character, sometimes dropped entirely for years and again prosecuted as occasion required, but the work, so far as it has been done, is, to say the least, equal in accuracy to any that I know of in this country. This work was begun under the late Chief Engineer, Samuel L. Smedley, and has recently been continued by his successor, Mr. Geo. I. Webster. One of the principal stations in this triangulation is the center of the City Hall tower, and, while the observations have not been conducted for that purpose, we have had occasion to keep an eye on the building, and though a good many things have walked off in that vicinity of late, we have never detected, with the best instruments, any such tendency in the tower. In taking angles to the tower no greater range of observations has occurred than is usual with other points. The same may be said of many angles observed from the tower. Last July ten angles were measured from the tower, at least six sets of twelve repetitions each being taken on each angle and sometimes more. These sets were measured at different hours of the day, under radically different atmospheric conditions. Some of the objects sighted were church spires and others of a permanent character; on other points heliotropes were used, which made sunlight a condition of visibility. The entire mean range of observations on the whole ten angles was 3.42 seconds, which renders extremely improbable any such movement as Mr. Grimm claims.

In October, 1888, a number of angles were measured at the center of the tower, which closed the horizon with an error of .16 of a second. In July, 1893, one of these angles was remeasured with a different instrument made by a different maker. The result differed only two seconds from the first measurement. If any such change was going on as Mr. Grimm claims, it could not fail to be indicated by the delicate levels attached to the triangulation instrument. As a matter of fact the levels indicated less movement on the top of the tower than at any other station in Philadelphia.

That some movement takes place I do not doubt, but it cannot be great and must be very slow. The center of the tower was instrumentally reduced to the level of the street in 1888 and carefully referenced. The work was executed with the utmost possible precision with one of the best coast survey theodolites, and a repetition of the process would, at any time, reveal with certainty exactly what change has since occurred in the position of the tower. Until some such test has been made I shall continue to doubt any merry-go-round theory in regard to the most conspicuous object in Philadelphia.

Respectfully yours, Neville B. Craig.

Philadelphia, Pa., Nov. 7, 1893.

THE NEW YORK RAILROAD COMMISSIONERS' REPORT ON BRIDGE STRAINS.

Sir: A short time ago I bought a copy of the Report of the Railroad Commissioners for the state of New York for 1891, which was said to give complete strain sheets of all the bridges on all the railways of the state.

On looking over the book I find that while the strains in the truss members have all been calculated and clearly shown, the floor is apparently ignored. In through spans, at the foot of the table of strains, the dimensions of the floor beams and stringers are given, but the strains of these members are not given, nor are the connections of floor beams to stringers or to the truss, or the strains in these connections, given. Surely the strains in the floor system and its connection are fully as important as those in the truss members. It is my experience with old bridges that the floor system and connections are generally much the lightest parts of the bridge; when the trusses are fairly up to present loads, the floor is only about one-half of the weight it should be. Probably the bridges were originally caluculated for a load of so many pounds per lineal foot, and the same load used for the floor as for the trusses. I am not making any criticism on the engineer who calculated the spans, but express my disappointment with a book which, did it give the figures mentioned, would contain very valuable information. A casual glance over the book would lead one to believe that eastern railways are far behind western ones in the matter of bridges.

Yours truly,

C. D. Purdon, M. Am. Soc. C. E.

Topeka, Kan., Nov. 4, 1893.

WICKES IMPROVED REFRIGERATOR CAR.

An improved form of the Wickes refrigerator car has been brought out by the Wickes Refrigerator & Car Co., of Chicago. The plan of framing has been improved, the new car having six longitudinal sills 4 × 8 ins., and end sills 6 × 8 ins. The body framing is similar to that of heavy box cars, and the walls are 1 in. thicker than in the older cars. The car has been designed in accordance with the M. C. B. standards. The insulation of the floor, sides and roof is of planking and wool felt, with air spaces between. The older cars had two ice tanks at each end, with 4-in. air spaces around them, while the new cars have one tank at each end, fitting closely against the sides and end of the car. Each tank has a capacity for 3,000 lbs. of ice, and the larger body of ice lasts longer than when distributed in the smaller tanks. The wire netting formerly used to suspend the drip water in the air current has been dispensed with, as it was found to collect straw and dirt from the ice, thus putting a mass of decaying matter in the air current. The interior arrangements have been much simplified. Improved doors and hatchways are used, and a new arrangement of meat racks has been introduced. The floor is made with gutters, each leading to a trap which is airtight when dry, being automatically plugged as soon as the water drains out of the waste pipe. The general dimensions of the cars are as follows:

Length over end sills	36 ft. 0 ins.
Width over side sills	8 ft. 6 ins.
Width inside	7 ft. 8 ins.
Height inside	7 ft. 10½ ins.
Height, top of sill to running board	9 ft. 1¾ ins.
Wheels, diameter	3 ft. 0 ins.
Journals	4½ × 8 ins.
Truck wheel base	5 ft. 0 ins.
Distance c. to c. of trucks	25 ft. 4 ins.

STORAGE BATTERY CARS ON SECOND AVE., NEW YORK CITY.

There is a general feeling among engineers at the present time that the storage battery stands no chance in competing with the trolley system for street railway service. So many storage battery systems have been announced with a flourish of trumpets, have been subjected to thorough practical tests, and have finally proved flat failures commercially that the impression is very general that until some radical improvements are made in the storage battery its commercial success on street cars is impossible.

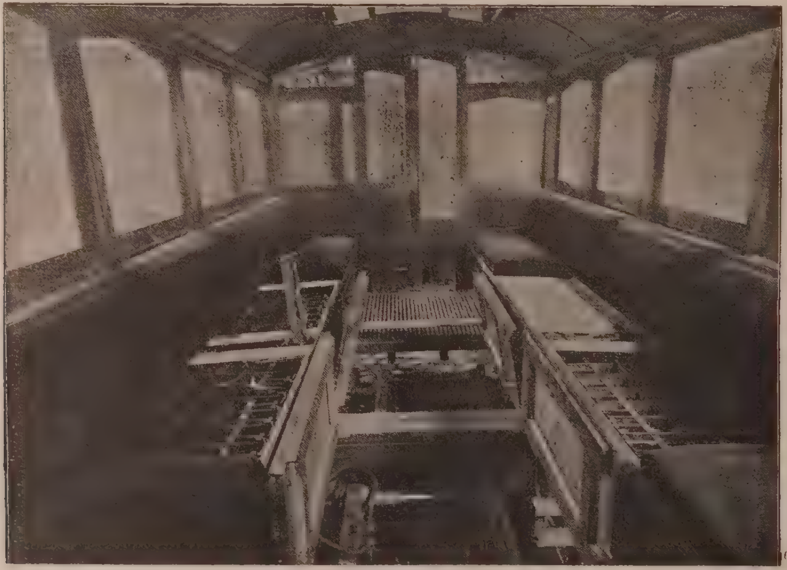
But during the past six months some storage battery cars have been operated on the Second Ave. surface road, in New York city, whose success has been such as to at least deserve the attention of engineers. Up to Oct. 15 these cars have made 40,000 car-miles. Since Aug. 1 the cars have operated between 92d and 129th Sts., at five-minute intervals, from 6.55 a. m. to 6.15 p. m. daily, making an average daily service of 400 car-miles. We understand that not a single delay to traffic has occurred because of the storage battery cars, and that the cars have missed less than ½% of their schedule trips during this time.

The equipment on each car consists of 144 cells of Waddell-Entz storage battery, weighing 4,200 lbs., and two 25-HP. Waddell-Entz motors. The battery cells are in a double row on two trays, each tray slipping in underneath the side seat of the car. Each cell gives an E. M. F. of about 0.82 volt, and stores about 270 watt-hours when fully charged, so that the total power stored is about: $\frac{270 \times 144}{746} = 52$ E. HP.-hours. Thus the proportion of power stored to weight of battery is about 81 lbs. per E. HP.-hour. On the Second Ave. line one charging of the batteries is sufficient to run the car from 2½ to 3 hours, in which time it makes about 20 miles, using about half the energy stored in the cells. About 40 to 45 amperes is the current at which the cells are ordinarily discharged.

Each car has two sets of batteries, so that one set is in service while the other is being charged. The machinery for removing and replacing the batteries is very complete. The car is run up to a platform and the doors forming the end panels are opened. An iron arm attached to the end of a cable is hooked onto the trays containing the cells, and a winding drum operated by an electric motor draws the trays out onto the platform; the tray moves on rollers in the platform and in the floor of the car which make its motion smooth and easy. The car is then moved sidewise 18 ins., so that it comes into line with the freshly charged batteries which have been previously deposited upon the platform. The batteries are shoved into place, the end doors are closed and the car is again ready for service, the entire operation from the time the car moves up to the shifting platform until it leaves it occupying only about four minutes. Meanwhile the battery which was taken from the car is picked up by a two-ton electric traveling crane made by Wm. Sellers & Co., and hoisted to the charging-room on the floor above. A charged battery is taken from the room and lowered to the platform ready for the next car.

The Waddell-Entz cell contains no lead, and no acid. The positive element consists of finely divided copper held about a central copper wire by fine wire netting, and an outside covering of cotton. Thus the finished product resembles an insulated wire in appearance. This is wound spirally to form a rectangular plate, and several of these plates are placed in an iron case alternated with iron plates. The electrolyte is a solution of potash in which zinc has been dissolved. When the cell is charged the zinc in the solution is deposited on the iron plates and the finely divided copper is oxidized. In discharging the zinc is redissolved and the copper is reduced. Each cell measures 4⅜ × 7½ × 11¾ ins., and weighs 29 lbs.

A point of great advantage is that the E. M. F. of the cell remains constant during the discharge until the cell is exhausted and is not much elevated during charging. While the cells are on the charging floor, they are heated by steam coils to a temperature of about 45° to 50° C. to reduce the internal resistance and effect a circulation of the electrolyte. Of the 144 cells, 16 are connected to a separate circuit, which is used to excite the field magnets of the motors and to operate the incandescent lamps by which the car is lighted. The motors are of the single-reduction type, and are so arranged that they can be safely reversed to stop the car in an emergency, the motor then acting as a dynamo. The charging plant in use at the station consists of two 100-HP. Worthington boilers and two 75-HP. Ideal engines direct connected to two Waddell-Entz dynamos.



VIEW IN INTERIOR OF WADDELL-ENTZ STORAGE BATTERY CAR ON SECOND AVE., NEW YORK CITY. SEATS PARTLY REMOVED TO SHOW BATTERIES.

Detailed figures of the cost of operation vouched for by the Waddell-Entz Co. are as follows, covering the system on which the plant has been run during the past three months:

Two engineers at $18 per week	$36
Two switchboard men at $15 and $16	31
One man to hook on at shifting table	9
" " " " " in battery room	9
Total for operating force	$85
Two battery men at $9 per week	18
Two repair shop men at $9 per week	18
Coal, 15.8 tons per week at $3.42	54
Oil, waste and water	5.60
Depreciation of batteries, including cost of replacing damaged cells	43.12
Total operating expenses per week	$223.72

Operating expenses per car mile as follows:

Operating force	3.54	cts.
Battery men	.75	"
Repair shop force	.75	"
Fuel	2.75	"
Oil, waste and water	.20	"
Renewals, motor gears, etc	.30	"
Depreciation of batteries	1.54	"
Total	9.32	"

It is fair to say that the above figures do not show what the system is capable of in practice, as the generating station, crane and delivery table could handle a much larger number of cars than are now in service. The company estimates that with 18 cars, making 80 miles each per day, the operating expenses could be reduced to 5.29 cts. per car-mile, divided as follows:

Operating force	1.31	cts.
Battery men, double present force	.42	"
Repair shop force, double present force	.42	"
Fuel	1.15	"
Oil, waste and water	.15	"
Renewals, motor gears, etc	.30	"
Depreciation of batteries	1.54	"
Total	5.29	"

The cars have recently been put into operation on the lower section of the road extending to Astor Place and Broadway, a round trip of 12½ miles, including several long grades.

LOCOMOTIVE DEVELOPMENT AT THE COLUMBIAN EXPOSITION.

The Baltimore & Ohio R. R. Exhibit.

The magnificent exhibit of actual engines and full size models illustrative of the development of the locomotive, which was prepared by the Baltimore & Ohio R. R. for the World's Columbian Exposition, has already been noted in our columns, and it is undoubtedly by far the most complete and comprehensive collection of its kind ever made or exhibited. It has been an object of attention to nearly every one of the thousands of visitors to the Transportation Building, and it is satisfactory to know that the collection will remain intact and that Major Pangborn, the agent in charge for the railway company, who has had much to do with the gathering of the material and information, is preparing a book descriptive of the exhibit. The actual engines and the full-sized models form but a part of the exhibit, there being some hundreds of large photographs and drawings of old and modern locomotives of all parts of the world, but these are too numerous for detailed mention here. Neither can we describe all the locomotives exhibited, but the following notes will present a clear and concise idea of the development of the locomotive as illustrated by this collection.

At the head of the "procession," which occupies four tracks the entire length of the annex of the Transportation Building, is an engine suggested (but never built) by Sir Isaac Newton, in 1680, which is said to embody the first idea of steam propulsion on land, of which there is any record. It was for propulsion on highways, and consisted of a kettle-shaped boiler on four wheels, with a horizontal nozzle at the rear, propulsion being effected by the reaction of the steam jet. Next came the steam road engine built in 1769-71 by Cugnot, of France, and the experimental engine built in 1784 by Murdock, who was James Watt's assistant. An engine patented in 1784 by Nathan Read, of Salem, Mass., and shown by a model built from the patent drawings and specifications, has a vertical multitubular boiler and horizontal cylinders with racks on the piston rod gearing with pinions on the hubs inside the wheels.

Trevithick's locomotive of 1800, with a flywheel, is followed by that of 1803-4, which was geared like a traction engine, and was the first locomotive to run on rails. Then comes the "Oructor Amphibolis," the curious locomotive and steam barge built by Oliver Evans, of Philadelphia, Pa., in 1804; and this is followed by another Trevithick engine, 1808, and Blenkinsop's engine, 1811, with driving pinions gearing with a rack alongside the track, as the adhesion power was not then recognized. A novel arrangement, which dispensed with driving wheels, was that of Wm. Brunton, of England, 1813, in which movable legs and feet pushed the engine along. In 1812 Wm. Hedley, of England, made careful experiments to demonstrate the adhesion of smooth wheels on smooth rails, and a model of his apparatus is shown, together with his locomotive "Puffing Billy," built in 1813. The first locomotive designed and built by George Stephenson was the "Blucher," 1814, a four-wheel engine with two vertical cylinders and connecting rods from the crossheads driving two pinions gearing with spur wheels on the axles. The "Seguin," 1828-29, is a Stephenson engine remodeled by Marc Seguin, of France, and fitted with the multitubular type of boiler patented in the United States by Nathan Read, 1791; in France, by Seguin, 1827; and in England by Boult, 1829. It has four wheels, a vertical cylinder with horizontal beam pivoted at the middle to the piston rod and carrying at each end a vertical connecting rod, while the coupling rod between the wheels completes the parallelogram. There is a fan on the tender, with canvas hose to the firebox. Then comes the full-size model of the "Rocket," as designed and constructed by George Stephenson in 1829, with inclined cylinders above the firebox. This engine was afterward remodeled and the cylinders placed lower down, and it is now in the South Kensington Museum, England. Hackworth's "Sans Pareil," and Braithwaite and Ericsson's "Novelty," which ran in competition with the "Rocket" in the great Rainhill trial in 1829 are shown. Then comes the "Stourbridge Lion," 1829, designed and built by Foster & Rastrick, of England, and the first actual locomotive seen in the United States (Eng. News, Jan. 11, 1890). This is followed by Peter Cooper's little "Tom Thumb," which was built in 1829, before the English engine had arrived, and on Aug. 28, 1830, it hauled the first American railway train propelled by steam.

Up to this date the locomotives, while embodying some of the features now in use, were in appearance totally unlike the engines of to-day, but in the locomotives representing the period between 1830 and 1840, we begin to see the inception of modern types. George Stephenson's "Mercury," built in 1830, was the first of the Planet class which was extensively used. It had inside cylinders, small leading wheels and a single pair of driving wheels in the front of the firebox, and later a pair of small trailing wheels was added, making the engine the first of a type which (on an enlarged scale) is to-day a standard on nearly every English railway and on many continental railways. The "Best Friend," 1830, designed and built by E. L. Miller, at the West Point Foundry, N. Y., was the first locomotive built for actual service in America. This engine, which, like several others here mentioned, is described in many books on the steam engine, had a vertical boiler, inclined cylinders driving a crank axle, and four wheels with coupling rods. The frame was inside the wheels. In 1831 the Baltimore & Ohio R. R. offered a prize for the best locomotive, and five engines were entered in competition: The "York," "Costell," "James," "Johnson" and "Child." The latter, built by Ezra Child, of Philadelphia, was a rotary engine, and is thought to have been the only rotary locomotive ever successfully operated. The prize was awarded to the "York," designed and built by Phineas Davis, of York, Pa. It was a four-wheel engine with vertical boiler and vertical inverted cylinders, the connecting rod being fitted to a pin on the middle of the coupling rod. It was remodeled the same year, and the cylinders placed at one end, nearly vertical, and driving the main axle by spur gearing. Its weight was 3½ tons. In 1832 came the first of the American "grasshopper" type, the "Atlantic," also built by Phineas Davis. It weighed 6½ tons, and the old engine itself, with some others of its class, is in the exhibit. Four other notable engines of 1832 are also shown, as follows: First; the "Old Ironsides," by M. W. Baldwin, of Philadelphia, was the first Baldwin engine, and was almost identical with Stephenson's "Planet" class. Second; the "South Carolina," designed by Horatio Allen, and built at the West Point Foundry Works, was the first eight-wheeled engine, and had two double horizontal boilers with a firebox between the barrels (Eng. News, Jan. 11, 1890). Third; the "Experience," designed and built by John B. Jervis, of New York, was the first locomotive in the world with a forward truck or "bogie," and had inside cylinders, a single pair of driving wheels, and a four-wheel truck with friction roller side bearings. Fourth; the "James," designed and built by W. T. James, of New York, was the first locomotive in the world fitted with the link motion; it had a vertical boiler, four wheels (not coupled), and inclined cylinders driving a spur wheel shaft directly above the driving axle.

The old Baltimore & Ohio grasshopper engine "Thomas Jefferson," the first of Ross Winans' engines, built in 1835, is exhibited just as it came from service in the Mount Clare yard of the B. & O. R. R., in 1893, after 58 years continuous service. It has four wheels, with coupling rods, and a spur wheel shaft driven by the connecting rods. The "Campbell," designed by Horace R. Campbell, of Philadelphia, and built by James Brooks, of that city, in 1837, was the first of the "American" or "eight-wheel" type, a type which forms a large percentage of the locomotive equipment of American railways, and is used to a large extent in other countries. The cylinders, however, were inside the frames, a practice long ago abandoned in this country. The "Mazeppa," 1837, is the first of the "crab" engines, being a grasshopper engine rebuilt, with outside horizontal cylinders driving the spur wheel shaft directly by the connecting rod, and having the guides attached to the frame instead of to the cylinders; it had four wheels, with coupling rods. The "Hercules," 1837, designed and built by Eastwick & Harrison, England, was the first locomotive fitted with equalizing levers; it was an eight-wheel engine with outside cylinders driving the rear axle. The "Lafayette," 1837, was built by Norris, of Philadelphia, for the steep grade of the Columbia incline at Philadelphia. It had a four-wheel truck, outside inclined cylinders and a single pair of driving wheels. It is interesting to note here the well known fact that in 1837 Norris sent a similar engine, the "Philadelphia," to England to work the Lickey incline on the Birmingham & Gloucester Ry. This 3.3%-grade, about two miles long, had baffled the English locomotive builders, and they were puzzled and annoyed at the successful performance of the American engine. Four of these Norris engines were purchased to operate the incline. The first locomotive (No. 1) of the Philadelphia & Reading R. R. was the "Rocket," designed and built in England by Braithwaite & Co., in 1838, and sent to America that year. It had four wheels of equal diameter, but not coupled, and its cylinders were under the smokebox. Two engines built by Hackworth, of England ("Samson," 1838, and "Albion," 1839), and sent to Nova Scotia in 1839, were six-wheel (all coupled) engines with cast iron wheels. The "Samson" has outside vertical inverted cylinders driving the rear pair of wheels, and has been in service on the railways for 45 years. The "Albion" has inclined cylinders at the side of the smokebox, with connecting rods driving the middle pair of wheels, which have blind tires. This engine has a primitive headlight consisting of a basket or cresset of iron rods hung in front of the smokebox and used to hold sticks of blazing pitch pine.

The engines designed by Ross Winans for the B. & O. R. R. now come into prominence, and the size of the locomotives shows a very marked increase. The "Buffalo," a Winans engine built in 1844, was the first eight-coupled engine, and had a vertical boiler and outside horizontal cylinders driving a spur shaft; the four inner wheels had blind tires. The "Mount Clare," 1845, designed and built by James Murray, of the B. & O. R. R., was another eight-coupled engine, but with horizontal boiler and inside horizontal cylinders under the smokebox; like the "Buffalo," it had spur gearing and blind tires on the four inner wheels. The coupling rods were rough eyebars, and the set of these rods looks like a piece of an old bridge chord. The "Camel," 1848, was another Winans eight-coupled engine, with outside horizontal cylinders driving the third axle, and having single bar guides and heavy crossheads; the cab was at the middle of the boiler, and the four inner wheels had blind tires. The "Dragon," built by Baldwin in 1848 for the B. & O. R. R., was similar to the above, but had inclined cylinders, and was fitted with a pilot, or "cowcatcher," headlight and diamond stack. This engine was designed for burning Cumberland coal, and was the first in which Baldwin introduced rocking grates. The "Camel," 1852, was a ten-wheel engine, with blind tires on the first four driving wheels. It was designed by Winans as an eight-coupled engine, but a four-wheel truck was substituted for the front pair of drivers by S. J. Hayes in order to facilitate the passage round curves. The engine has outside inclined cylinders, balloon smokestack, headlight, pilot, and a cab on the boiler, at the front end of the big anthracite-burning firebox, the top of which sloped down behind the cab. Many of the features of this boiler were followed in the Wootten boilers. A regular four-coupled eight-wheel engine built by Wm. Mason, of Tannton, Mass., is dated 1853. The little "Peppersauce," 1863, designed by Sylvester Marsh, and built by the Whittier Machine Co., of Boston, for the Mount Washington R. R., in New Hampshire (3¼ miles long), was the first mountain climbing locomotive in the world. It had a vertical boiler so placed as to be vertical on the maximum grade of 37%. This engine was propelled by cog wheels gearing with the Marsh ladder rack.

The "Perkins," 1863, was a ten-wheel engine, designed by T. Perkins, and built by the B. & O. R. R. for passenger service on mountain divisions. The four leading drivers had blind tires. The engine had outside horizontal cylinders, four-bar guides and a balloon stack. The "Mogul," 1876, also built by the B. & O. R. R., was the first mogul engine for passenger service, and was a notable engine at the Centennial Exposition. It had driving wheels 5 ft. diameter, with blind tires on the middle pair; cylinders, 19 × 26 ins.; 165 tubes, 2¼ ins. diameter and 11 ft. 10½ ins. long; heating surface, 1,272 sq. ft. (tubes, 1,150 sq ft.); grate area, 23.7 sq. ft.; and weighed 90,400 lbs., with 76,550 lbs. on the driving wheels. It had single bar guides, a deep diamond stack, and the feed pumps were worked by rods from the rear crankpins. This completes the collection of historical locomotives, but on the next track are two Baldwin eight-wheel engines, built in 1893, for the Blue Line express service of the Baltimore & Ohio R. R. One of these is a simple engine, and the other a Vauclain four-cylinder compound.

Other Historical Locomotives.

In addition to the above collection of the Baltimore & Ohio R. R., there are six engines exhibited separately. The New York Central R. R. shows the "De Witt Clinton," built at the West Point Foundry, in 1831, for the Mohawk & Hudson R. R., and which hauled the first passenger train in America on Aug. 9, 1831, from Albany to Schenectady, N. Y. It is a four-wheel engine, with inside cylinders, and weighed only five tons (Eng. News. April 27, 1893). The Pennsylvania R. R. shows the "John Bull," built at Stephenson's works at Newcastle, England, in 1831, for the Camden & Amboy R. R. This was also a four-wheel engine with inside cylinders and cranked driving axle, but weighed 16 tons (Eng. News, Jan. 18, 1890; April 27 and June 1, 1893). The Illinois Central R. R. exhibits the "Mississippi," built in England in 1834, and brought to the United States in 1836. It was in service on the Natchez & Hamburg R. R., 19 miles long, in Mississippi, until 1838. In 1868 it was removed to Vicksburg and remained there until 1878, when it was put on the Meridian, Brookhaven & Natchez R. R., a line seven miles long running east from Brookhaven, Miss., and now controlled by the Illinois Central R. R. It continued in service there until a few years ago. The engine has four wheels, 3 ft. 7 ins. diameter; bar frames, outside horizontal cylinders 9½ × 16 ins.; steam chests above the cylinders, single-bar guides, and link motion, and weighs 14,000 lbs. A lofty cab with open sides extends from the footplate to the smokebox. The tender is on four wheels and has a horseshoe tank. The engine and tender stand on a track of 18-ft. strap rails (brought from England in 1836) laid on longitudinal timbers supported by crossties. The Chicago & Northwestern Ry. exhibits the "Pioneer," the first locomotive ever run out of Chicago, its initial trip having been made Oct. 10, 1843, on the Chicago & Galena Union R. R., now a part of the C. & N. W. Ry. system. The engine was built by Baldwin, of Philadelphia (being the 37th engine built by him), in 1836, for the Utica & Schenectady R. R.; was purchased in 1843 by the Chicago & Galena Union R. R., and has been in service about 35 years. It has a bar frame, outside inclined cylinders, 11 × 18 ins.; a single pair of driving wheels behind the firebox, and a four-wheel leading truck. The eccentrics are outside the driving wheels. The boiler is of the T or boot pattern, and has a conical smokestack. The engine weighs ten tons. The track consists of crossties 3 ft. apart, upon which are longitudinal timbers carrying a 1-in. oak strip and a ¾-in. strap rail.

The two other engines are of more modern style. The "Daniel Nason," exhibited by the Old Colony R. R., was built at the Boston & Providence R. R. shops, at Roxbury, Mass., in September, 1858, under the direction of C. S. Griggs, Machinist. It is an eight-wheel engine, with inside horizontal cylinders, having the steam chests above the cylinders, and the crossheads having two-bar guides. The truck has a very short wheel base. The driver springs are equalized. The tender has three axles, one at the front end, and two close together at the rear end. There is a brakeshoe to each tender wheel. Chatillon's spring balance safety valves are fitted in the base of the large bronze pillars which carry the bell. The engine has an appearance of barbaric splendor, being painted in bright red and green, with much brasswork and gilt striping. Finally, there is the old warhorse "General," stolen from a Confederate train on April 12, 1862, by Andrews' raiders, who made a desperate attempt to wreck the Western & Atlanta R. R. between Atlanta and Chattanooga. The attempt was frustrated by prompt pursuit by the Confederate trainmen with another engine, and Andrews and his associates were captured and executed. The engine is an old-fashioned eight-wheeler, with a very large balloon stack.

BURNT CLAY BALLAST.

By S. E. Coombs, Assistant Engineer,

Hannibal & St. Joseph R. R.

In localities where gravel beds cannot be found, and broken stone is considered too expensive or is of too poor a quality, the so-called burnt clay ballast has come into extensive use, and some of the large railway systems in the Missouri Valley are using it in preference to any other ballast.* In locating a pit or kiln, a good clay is sought, and almost any clay can be used if free enough from sand. A light clay is preferred on account of ease of handling. The so-called gumbo is used throughout the West, and in Texas it is proposed to turn "black wax" to some account by making ballast of it. As the available clay is always on bottom lands, it is often difficult to obtain good drainage, but the importance of this must not be underrated, as on this very factor will often depend the economical working of the kiln. Consideration must also be taken of the prevailing winds so that they will help both to dry out the clay and fan the fires. The kiln and tracks are arranged, as shown in Fig. 1, varying with the ground.

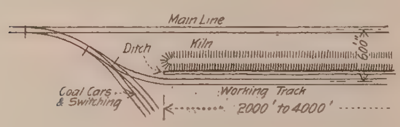


Fig. 1.
Arrangement of Tracks.

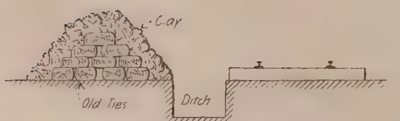


Fig. 2.
Section of Kiln at Starting.
Main Line on Left.

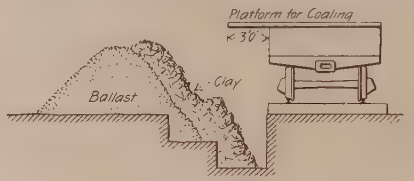


Fig. 3. Cross Section of Kiln at Beginning of Machine Work.

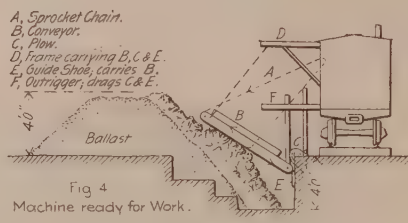

A, Sprocket Chain.
B, Conveyor.
C, Plow.
D, Frame carrying B, C & E.
E, Guide Shoe; carries B.
F, Outrigger; drags C & E.
D
A
F
B
C
E
4'0"
4 ft
Ballast

Fig 4
Machine ready for Work.

MANUFACTURE OF BURNT CLAY BALLAST.

The working track is simply laid on the surface so that it can readily be thrown. No very heavy work comes on it till ballast is loaded out. The kiln is started on a triangular core of old ties and kindlings (Fig. 2) piled about 3 ft. high, and the entire length of the kiln, which varies from 2,000 to 4,000 ft. The kiln is often started for a short length, say, 2,400 ft., and lengthened as economical working permits. This core is filled with coal and covered about a foot deep with clay, and the fires are lighted. After this has burned down somewhat, the work is begun on the side toward the working track. The laborers simply cover the side of the kiln with a layer of coal, and this coal with a layer of clay 6 ins. to 9 ins. deep. The work is carried on by hand until a sufficient height is reached to use the machines. When the clay is, in the opinion of the operator, sufficiently burned, the kiln is drawn; that is to say, part of the unburned clay is drawn off the fire and a layer of coal scattered over the surface sufficient for burning the next layer of clay, which is from 6 ins. to 9 ins. thick. This is shown by Fig. 3.

The spreading of coal is done entirely by hand from a platform about 10 × 3 ft., rigged over the side of the gondola car which carries the coal, and which can be transferred to each car. Scoop shovels are used, and with very little skill the operators can distribute the coal thoroughly over the surface of the kiln. Coal is also distributed over the surface of the ground, before plowing, so that it gets mixed in the clay and helps to start the new fires after drawing. The plowing, both from the sides and the bottom of the ditch, is done by the machine.

The plant is simple, consisting of two double engines; one set of 10 HP., and one of 5 HP., mounted on a flat car. The 10-HP. engine is geared to trucks for locomotion and also does the plowing; the other runs the conveyor, which distributes the clay over the kiln, both operated by one man. Alongside the car, on a rigid frame (but itself movable) is the plow. The conveyor is independent of this, and has one end just below it, so as to catch the dirt which is plowed from the sides of pit. These conveyors are rubber belts, 4 ft. wide, and are run by sprocket wheels or by friction, and are adjustable. The cost of one machine complete is about $3,500.

The method of operating machines is as follows, and is easily understood by reference to Figs. 4 and 5. Clay plowed from the bottom of the ditch is piled up by hand to a height of about 4 ft. to make a sort of shoulder. The plant is then put in motion at a speed of about 200 ft. per minute, plowing from the side and distributing at the same time. When the height of the kiln gets beyond reach of this machine, another is put into service with it, having a longer conveyor, to reach the top of the kiln. The operation is kept up, requiring no skilled labor except in the superintendence and running of the machines. The principal object is to keep the fires always well covered with clay and burning. The fuel used is ordinary slack coal, and almost any variety of soft coal will do the work. About 560 lbs. of coal will burn about a cubic yard of ballast.

Along the Missouri and Mississippi valleys the best season for burning is from just after the so-called June rise to the spring rains. The work is usually done by contract, the railway company furnishing the land, tracks and coal. This method gives the best satisfaction, as the contractor does not feel bound to save coal, which would result in underburned ballast. Partial estimates are given on kiln measurements, and the final estimate is made from car measurements when loaded out, so that worthless material is not paid for.

About 1,000 cu. yds. per day can be burned in a kiln 4,000 ft. long, and about 50 men are required to operate such a kiln. The cost of ballast thus made is about $1.05 per cu. yd., distributed as follows:

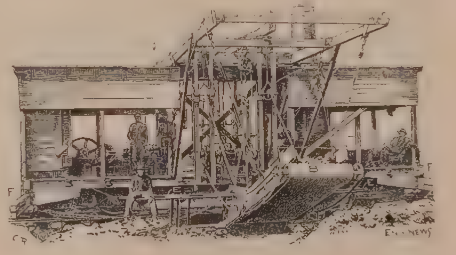


Fig. 5. Machine Used in Making Burnt Clay Ballast.

Contract price for burning	*38 cts.
Average cost of coal per yard	21 "
Loading on cars	8 "
Distributing	9 "
Putting under track	22 "
Interest and depreciation on track	4 "
Land	1 "
Miscellaneous expense	2 "
	$1.05

*Variable; this was the price in 1892.

This ballast makes very handsome and easy riding track and has been found satisfactory on most roads where rock is too expensive as compared with it. It is very light, weighing only 40 to 50 lbs. per cu. ft., and is thus liable to wash away. Its lightness, however, enables it to be handled cheaply. The principal objection to it is its low crushing strength, making it liable to powder up under the ties, and compelling shovel tamping, which is of itself often considered a great objection. It requires renewal in from six to eight years; is quite free from weeds, which are readily cut out; and is said by one superintendent to be easier on rolling stock than any other ballast on account of its elasticity. Figures for this are, however, practically unobtainable.

Track keeps in surface about one-half as well as with broken stone and about the same as with gravel. The same cross-section is used as with stone. It cannot be used sparingly, as less than 12 ins. under the ties will not give good results. Whether its use is economical is a question of management and locality. Side by side with good stone, however, the latter has the advantage in its superior permanency and stability. The process and machines are patented to some extent and the work is generally done by the patentees.

The cost given above, from five pits, is an actual average, and is high rather than low, as a contract for 50,000 cu. yds. was let this year for burning at 25 cts. per cu. yd., an extremely low price. The Wabash R. R. is paying 38 cts., I believe, near St. Louis. I have watched its behavior in the track very closely, and do not think it compares favorably with stone, especially in cost, though of course this is somewhat a matter of opinion. Section men like it because it is so easy to work. The general manager and the general superintendent of the Hannibal & St. Joseph R. R. and allied roads, the general superintendent of the Burlington & Missouri River R. R., and the division superintendent of the Wabash R. R. are very much in its favor. The chief engineer and two roadmasters of the Hannibal & St. Joseph and Michigan lines and the resident engineer of the St. Louis Extension are opposed to it. It may be in the future that the process will be improved so as to make a really first-class ballast. The "black wax" experiment is very recent, but bids fair to be successful. The patentees are the Stubbs Ballast Co., Weston, Mo.; the Western Burnt Clay Ballast Co., Cameron, Mo., and the Davy Clay Ballast Co., address unknown. All three have furnished ballast to the Hannibal & St. Joseph R. R.

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[*] Notes on the manufacture and use of this ballast are given in a paper on "Improvements in Railway Track," by Mr. E. E. R. Tratman, Trans. Am. Soc. C. E., Vol. XXII., pp. 148, 149. At the World's Columbian Exposition there is an exhibit of a country road made with burnt clay instead of broken stone, as noted in our issue of Nov. 9.—Ed.

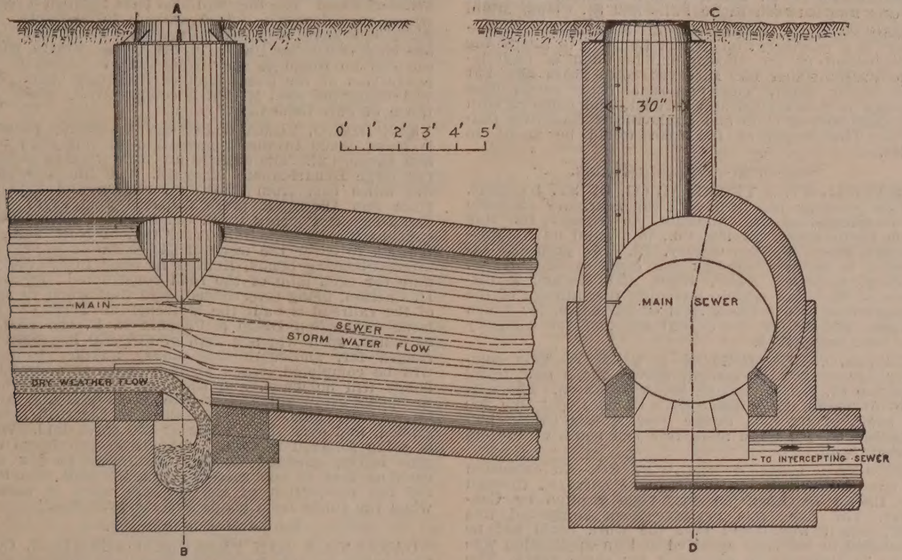
THE U. S. SURVEYS OF THE GREAT LAKES.

In the last report of Gen. Thomas Lincoln Casey, Chief of Engineers U. S. A., the following notes are given relating to surveys of the Great Lakes by the engineer officers:

The earliest maps of this character on file date from 1817, but up to 1841 these surveys were made in connection with the improvement of various harbors and of rivers tributary to the lakes. The needs of navigation demanded something more than these disconnected surveys and the act of March 3, 1841, appropriated $15,000 for a commencement in a "hydrographic survey of the coasts of the northern and northwestern lakes of the United States." This work was naturally assigned to the War Department, and Capt. W. G. Williams, then stationed at Buffalo, N. Y., was directed to take charge of the survey under this appropriation, on May 17, 1841. A few years later the office was transferred to Detroit, Mich., and that place has since remained as a point of distribution for the charts of the lakes, the fieldwork of the survey having been completed in 1882. From March 3, 1841, to Aug. 7, 1882, the total sum of $2,939,879 was appropriated for this work.

The printing of the final report was completed in November, 1882, with the charts perfected to the full needs of navigation under their existing conditions. Up to June 30, 1893, an aggregate of $7,797.80 had been turned into the Treasury from the sale of charts. Up to Feb. 20, 1890, charts had been issued free to vessels navigating the Great Lakes, one set to each vessel, and all extra charts 30 cts. each. After the last date the free distribution ceased and all charts were sold at 30 cts. until July 16, 1890, since which date the price has been 20 cts.

The phenomenal increase of commerce on the Lakes and the increased depth made practicable by the competition of the new lock on the St. Mary's River have resulted in the steady increase in draft of lake vessels and require the re-examination of certain shoaler areas which had been chartered for the old 12-ft. navigation. As a consequence, $55,000 has been expended since March 2, 1889, in these surveys. The St. Mary's River, with its 9,000,000 tons of freight passing through annually, especially requires new surveys, as the present charts are based upon surveys of 1853 and 1857, and in the meantime the draft of vessels has increased from 9½ and 12 ft. to 16 ft., and will shortly be increased to 20 ft. This river is now a difficult one to navigate with the present large vessels. General Casey says it will require $40,000 to complete the survey of this river, and he earnestly recommends that the appropriation be made as soon as possible.



Longitudinal Section on C-D.

Cross Section on A-B.

DEVICE FOR SEPARATING SEWAGE FROM STORM WATER, MILWAUKEE SEWERAGE SYSTEM.

THE IMPROVED SEWAGE DISPOSAL SYSTEM OF MILWAUKEE.

The accompanying illustration shows the manner in which the dry weather sewage flow of twelve old outlet sewers at Milwaukee, Wis., has been diverted from the Menominee River, while the storm water flow is carried into the river as before. The dry weather flow drops into a channel and is carried to an intercepting sewer, while the storm water flow, by reason of increased velocity, is carried over the transverse channel and on through the old sewer. The illustration was inadvertently omitted from the article on p. 369 of our last issue, having the same title as that given above.

The Ferris wheel at Chicago, says Secretary Vincent in his report to the stockholders, carried 1,453,611 passengers at 50 cts. each. The receipts were thus $726,805.50. After paying off $300,000 due on the bonds the company divided equally with the Exposition $426,805.50; and after deducting operating expenses, the sum of something over $150,000 was divided between the stockholders. Offers of purchase have been received from Coney Island, New York, London and Antwerp; but as none of these were satisfactory, the wheel will remain in Chicago for the present.

Long bridges are unusually plentiful on the line of the Buenos Ayres & Rosario Ry. in South America. Two of these crossing the Salado and Dulce rivers are over a mile long, or, exactly, 6,733 ft. 9 ins. and 6,162 ft. 6 ins. long, respectively. The Salado River bridge consists of 80 approach spans 65 ft. 3 ins. long each, and 12 main spans 126 ft. 6 ins. long each. The approach spans are carried on cast iron screw pile piers, and the main spans are wrought iron cylinder piers filled with concrete. The Dulce River bridge consists of 90 spans 66 ft. 3 ins. long, each supported on screw piles. Two other bridges, 2,283 ft. 9 ins. and 1,174 ft. 6 ins. long, respectively, are also composed of 65 ft. 3 in. spans. The first of these has masonry piers, and the second screw pile piers. A description of the Salado River bridge, given in London "Engineering," states that the screw piles are 1⅛ in. cast iron, with 2½ ft. diameter shaft and 4 ft. 1 in. diameter screw blade. Each pair of piles is braced together with a plate and angle bracing secured to bands clipping the piles, and on the top of each pile is a cap, to which the girders are bolted. The cylinders for the main piers are 8 ft. 6 ins. in diameter below and 6 ft. 6 ins. in diameter above the cones, and are made of from ½ to ⅜ in. wrought iron, with all points covered with bar and tee iron. The gage of the railway is 5 ft. 6 ins.

At the late trial of 6-pdr. rapid-fire guns, by the Navy Department at Indian Head, the Hotchkiss, Driggs-Schroeder and the Sponsel guns were tested. The board of officers making the trial now report the two first named types about equal in all points, with some slight difference in favor of the Hotchkiss. The Sponsel gun came in as a bad third, due to its tendency to rapid fouling and sticking of the mechanism and the blow-backs. The position of the crank also interfered with aiming. The other two guns were also quicker in action, and could be aimed and fired with greater rapidity, and could also be dismantled more easily. In rapid firing, aimed and unaimed, the Driggs was better than the Hotchkiss, and it required only two men to handle it, while the Hotchkiss and Sponsel each required three.

WEATHER TABLE FOR OCTOBER, 1893. [Furnished to Engineering News by the Department of Agriculture.]

	Stations.	Temperature. (Deg. Fahr.)				Wind.			Precipitation—rain and melted snow—inches.		
						Velocity in miles per hour.		Direction at time of max. velocity.			
		Average	Max.	Min.	Range.	Average	Max.		Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	47.6	76	14	62	9.9	60	S	1.54	0.50	10
	Portland, Me.	50.8	75	30	45	7.6	36	W	5.13	3.19	10
	New York, N. Y.	57.6	78	34	44	10.0	48	SE	5.28	2.56	8
	Pittsburg, Pa.	55.4	86	29	57	6.4	32	NW	3.22	1.27	10
	Chicago, Ill.	52.6	81	26	55	19.0	60	SW	1.75	0.80	7
	Omaha, Neb.	55.4	89	24	65	8.4	33	N	0.12	0.05	3
	St. Paul, Minn.	49.0	82	18	64	8.5	38	NW	1.49	1.05	11
	Duluth, Minn.	44.9	70	18	52	5.0	23	NE	1.84	0.97	10
	Bismarck, N. Dak.	42.4	74	10	64	10.7	45	NW	0.95	0.66	7
	Average	50.6	79	23	56	9.5	42	NW	2.37	1.23	8
Southern Cities.	Washington, D. C.	56.5	83	26	57	6.0	42	SE	4.11	2.17	7
	Louisville, Ky.	58.2	86	28	58	6.7	32	SW	5.10	2.63	7
	St. Louis, Mo.	58.6	88	33	55	12.1	36	W	1.66	1.43	5
	Savannah, Ga.	68.2	85	41	44	9.4	40	NW	6.91	3.99	6
	Leavenworth, Kan.	58.2	90	30	60	10.6	36	NW	0.48	0.35	2
	Jacksonville, Fla.	70.9	88	45	43	8.7	39	NW	4.48	2.99	10
	Chattanooga, Tenn.	60.2	84	27	57	5.6	30	NW	0.98	0.33	8
	New Orleans, La.	69.1	86	48	38	9.7	48	NE	4.24	2.75	6
	Memphis, Tenn.	61.1	87	34	53	6.2	28	NW	0.64	0.24	4
	Palestine, Tex.	67.4	97	40	57	5.6	22	NW	0.17	0.11	2
	Average	62.8	87	35	52	8.1	35	NW	2.88	1.70	6
Western Cities.	Helena, Mont.	42.2	67	20	47	8.0	48	SW	0.84	0.28	13
	Port Angeles, Wash.	45.9	59	28	31	5.1	26	W	3.61	1.02	13
	San Francisco, Cal.	57.6	79	47	32	9.3	32	SW	0.16	0.10	3
	Salt Lake City, Utah	52.0	77	30	47	5.2	28	NW	1.02	0.37	7
	Santa Fé, N. Mex.	49.6	70	30	40	6.0	30	NE	0.22	0.16	4
	Denver, Colo.	51.4	81	23	58	7.2	36	NE	0.84	0.51	4
	Yuma, Ariz.	72.0	98	49	49	5.4	28	N	0.01	0.01	1
	Average	53.0	76	32	43	6.6	33	NE and SW	0.96	0.35	6

The total production of all kinds of coal in the United States in 1892 was 160,115,421 gross tons (=179,329,271 net tons) valued at $207,566,381, says Mr. David T. Day, of the U. S. Geological Survey. This production included colliery consumption. The total output of Pennsylvania anthracite was 46,850,450 gross tons, valued at $82,442,000. The remainder, in tonnage and value, is all charged to bituminous semi-anthracite and semi-bituminous, cannel and lignite coals and to the comparatively small anthracite product of Colorado, New Mexico and Virginia.

The "staff" used so effectively on and about the exterior of the World's Fair buildings and in the statuary, columns and decorative work generally cost $1,891,688. The surface decoration alone cost $1,396,553. The 295 statues and figures of oxen, horses, etc., cost the Exposition company $495,135; the figures on the Agricultural Building aggregating nearly one-fourth of the total. The statue of the Republic cost $22,108, and the MacMonnies fountain, $65,000. While there will be absolutely no salvage on this material, no one will deny but that it was worth all it cost in impressive effect. The "staff" made the "White City" what it was—the most effective collection of exposition buildings the world had ever seen, or is likely to see for some generations at least.

The visitors to the Chicago World's Fair were almost entirely citizens of the United States and Canada. The best estimates possible only credit 25,000 to Europe, as passing through New York to Chicago and presumably attracted by the Fair alone. Between January and October of this year the increase in trans-Atlantic passenger traffic to New York was only 13,730 aliens and 8,838 citizens, according to the figures of the immigration commissioner on Ellis Island.

A balloon trip across the Baltic Sea, from Stockholm to the coast of Finland, has been made by Mr. S. A. Andree, chief engineer in the royal patent office, at Stockholm. Mr. Andree has been making a scientific study of ballooning, and started out on Oct. 19 in a new balloon, only expecting to be in the air a few hours. He was caught in a storm and sailed across the sea in less than 12 hours, landing on a deserted island, from which he was rescued by a passing fishing schooner.

Asphalt pavements formed the subject of a paper lately read before the Civil Engineers' Society of St. Paul by Mr. J. W. Howard, of Chicago. He said that asphalt pavement is now being used in about 71 cities in the United States, and covers an area of 11,913,707 sq. yds., equal to 781 miles of roadway. This work has been done by about 30 different contractors, and involved an expenditure of about $50,000,000 of city money. Mr. Howard places the total area of asphalt pavement in Europe, including Great Britain, at 2,063,000 sq. yds. This work has practically all been done since 1876, when asphalt pavement was successfully tested in Washington, and in 1878 was made the standard pavement of that city. He said this pavement could be maintained in good repair for less than 2½% per annum upon the value of the pavement.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

CANADA ATLANTIC.—Grading is completed on the Ottawa, Arnprior & Parry Sound Ry. to Golden Lake, 84 miles from Ottawa, and track is laid to a point three miles west of Arnprior. The latter city is 36 miles from Ottawa. The road is an extension of the Canada Atlantic, and is under construction from Ottawa, Ont., west to Parry Sound.

CINCINNATI, JACKSON & MACKINAW.—The stockholders of this road have voted to extend this line to Jackson, Mich., and into Cincinnati, O.

GRAND RIVER.—A press dispatch from Butte Creek, Mich., states that the engineer, Mr. J. Q. Cressy, employed by the English syndicate to report upon the cost and value of the Michigan road has just returned from a trip over the proposed route and says: "It is this syndicate that contemplates the purchase of the bonds. Mr. Cressy has walked every foot of the way from Grand Haven, via Grand Rapids, to Battle Creek. From Grand Haven to Grand Rapids the roadbed is all ready for the iron, and the road is an ideal one, the greatest grade is only 4 ft. to the mile. For many miles it is perfectly level. Nearly the whole distance is an air line. From Grand Rapids to Battle Creek the line is already surveyed. It runs through Hastings, Banfield and Bedford, and fine farm lands. Although the route has not been surveyed, it is also proposed to run the new road through what is known as the lake region, between here and Grand Rapids. Starting from this city the road would strike Gull Lake, Crooked Lake, Gunn Lake, Payne Lake, Barlow Lake and Green Lake. Mr. Cressy expresses a belief that the road will surely be built."

GRAND TRUNK.—It is stated that the Elmira Branch will be extended to Drayton, Ont., soon.

WASHINGTON & POTOMAC.—The "Baltimore Sun" refers to this old enterprise as follows in a recent issue: "The Washington & Potomac R. R., formerly known as the Southern Maryland, which has been surveyed and graded for nearly its entire length, ought to be finished, and the indications are that it must attract the attention of capitalists before long. It was built for 20 miles from Brandywine, in Prince George's county, to Mechanicsville, in St. Mary's county, some years ago and has been irregularly operated ever since. When it is finished from Brandywine to Washington, 17 miles, and from Mechanicsville to Point Lookout, about 40 miles, it will pass through a section not only attractive, but containing some of the very finest farming lands in the state."

Projects and Surveys.

ALPENA & NORTHERN.—This company has been chartered in Michigan with a capital stock of $700,000.

Southern—Existing Roads.

ADDISON & CENTRALIA.—A party composed of Senator J. N. Camden, Pres. West Virginia Central & Pittsburg; E. R. Bacon, Pres. Baltimore & Ohio Southwestern, and others, made a trip of inspection over the proposed line of the above road from Centralia to Addison, the county seat of Webster county, recently. The proposed road is to be a feeder for the West Virginia Central & Pittsburg road. It will pass through a good timber and coal country, and will develop a region 100 miles square which is at present without railroad facilities. The incorporators of the new line are all connected with the local interests of the West Virginia Central & Pittsburg and Baltimore & Ohio roads.

ALABAMA MIDLAND.—The extension of this road, known as the Abbeville Southern, is completed to Headland, Ala., and that place is now connected by rail with Montgomery.

FLORIDA CENTRAL & PENINSULAR.—This road proposes to run trains into Savannah, Ga., by Dec. 1, and orders have been given the engineering corps to arrange a schedule by that date. The Savannah extension will be probably completed before that date as there are only 25 or 26 miles of track between the Altamaha and Ogeechee rivers to be laid. All the long bridges have been completed, and the only bridge work remaining to be done is three or four short trestles. There are two gangs of hands now working on the track, comprising in all more than 100 men. With the continuance of good weather it is believed that the road will be completed by Nov. 20, or about that date. In that case the first train from Jacksonville over the Florida Central & Peninsular will reach Savannah before the end of the month. Ten new locomotives, with 19 × 24-in. cylinders, have been purchased from the Rogers Locomotive Works and are now at Fernandina awaiting the opening of the road. The contract for the car equipment was let for $250,000. The location of stations along the new line has been decided upon. There will be ten stations between Savannah and the Altamaha River. The names of these stations will be located as follows: Anderson, at the Little Ogeechee River; Burroughs, at the junction of the Savannah, Florida & Western Ry.; Way's road, Limerick plantation, Dorchester road, Riceboro, Jonesville road, the Darien Short Line junction, the King road and the Ferry road, near the Altamaha River. Sidings will be put in at all of these points and depots will be built as the business requires.

HARDING COAL CO.—This company is building a 2-mile road from its mines at Elkins, W. Va., to the main line of the West Virginia Central & Pittsburg road, and a line a mile in length between the two mines it operates. The work is being done by day labor.

Northwest—Existing Roads.

GREAT NORTHERN.—The contract for building a spur, 4½ miles in length, to granite quarries near St. Cloud, Minn., has been let to Foley Bros. & Guthrie, of St. Paul, Minn.

IOWA CENTRAL.—A survey is now under way for a connecting link between this line at Belmond, Ia., and the Mason City & Fort Dodge road.

Projects and Surveys.

LEECH LAKE & MISSISSIPPI.—A corps of engineers, under H. A. Rider, is now locating the route of this line between Little Falls and St. Cloud, Minn.

MASCOUTAH, LEBANON & FAYETTEVILLE.—There is a movement on foot at Lebanon to secure the construction of the Mascoutah, Lebanon & Fayetteville R. R., which was surveyed some years ago, but was never built. The proposed road would pass through a rich agricultural district, and connect with the Baltimore & Ohio and Louisville & Nashville railroads. The length of the road would be about 15 miles.

Southwest—Existing Roads.

CENTRAL RY. & TERMINAL CO. OF ST. JOSEPH.—This company has filed with the Secretary of State a certificate of its intention to extend its line from Pattonsburg, Daviess Co., to a point on the Mississippi River opposite Quincy, Ill. The proposed extension is to pass through the counties of Daviess, Grundy, Sullivan, Adair, Knox and Marion, a distance of 65 miles, which, including the mileage of the present line, will make a total of 285 miles, for which purpose $285,000 of the capital stock of the company has been subscribed.

CHICAGO, BURLINGTON & QUINCY.—This company has made a permanent survey for a new trunk line into St. Louis, through South Ferguson. The new line intersects the Wabash Ry.'s Union Depot line 200 ft. south of its new bridge over Moline Creek, and branches off from the main line just south of the old Bissell farm.

CHOCTAW COAL & RAILWAY CO.—An extension of time for completing the road as surveyed through the Indian Territory has just been granted by Congress. The road was to have been completed this year, but it was found that the work could not be concluded in the time specified and an application was made to Congress to extend it for three years. The road reaches valuable coal fields and mineral deposits, but owing to the lack of facilities for transporting the output they cannot be developed. The road is in the hands of receivers, and plans are being formulated for the construction of a connecting line, to join the Eastern and Western divisions. About 120 miles of road will be built between Oklahoma City and South McAlester.

NEW ORLEANS & NORTHWESTERN.—Concerning the construction of this road the Richland "Beacon-News" says: "Messrs. Bagnall & Johnson, of St. Louis, are the contractors, and they will have three divisions—one at Rayville, La., under Mr. H. A. Higgins; one at or near Oak Ridge, La., under Mr. McPherson, and the third at Collins, La., under Mr. Campbell. While these three divisions will do the grading and laying of steel, Messrs. M. S. Carter & Co. will build Boeuf River and Lafourche Lake bridges and all other trestlework. Stock and other supplies necessary for the construction have been shipped from St. Louis and are now en route to Richland and Collins. M. S. Carter & Co., of St. Louis, have the contract for bridge building. The contract dates from Oct. 28, 1893, and calls for the completion of the work in 90 days. Mr. Sherman, chief engineer and general manager of the road, is going over the line between Rayville and Collins. A good part of the right of way of this line was cut in 1890, also some little grading done. Boeuf River bridge was located by the United States engineers in 1891, so there will be no unnecessary delay on this account. When this link is completed to Collins, that place having been connected two years ago with Bastrop, the New Orleans & Northwestern R. R. will be about 101 miles long and will split in twain one of the finest agricultural countries in the world. Beside this, this road will then connect with the Houston, Central Arkansas & Northern R. R."

Projects and Surveys.

CORPUS CHRISTI & BROWNSVILLE.—Dispatches state that J. C. Russell, of Corpus Christi, Tex., G. M Raphael, of Brownsville, Tex., and C. D. Hess, of Point Isabel, Tex., are interested in the project of constructing a road along the valley of the Rio Grande from Brownsville to Laredo, Tex. Sidney G. Miller, of New York, is addressing citizens of various towns along the valley in favor of it. Mr. Miller also offers to build a line from Brownsville to Corpus Christi on the following terms: A bonus of $2,000 per mile to be paid by the people of Cameron, Hidalgo and Nueces counties, this bonus to be secured by notes executed and delivered to a trustee by all who propose to donate money, and deeds made and delivered to the trustee for lands at a reasonable value by those who will donate lands, one-third of said donation to be paid on the completion of 100 miles and the balance on the completion of the road from Brownsville to Corpus Christi, the completion of each section to be announced by a locomotive drawing a train over the portion of road so completed, work on the road to begin in 90 days from closing the contract, and to be completed and equipped in two years from the time work begins."

PALESTINE & DALLAS.—A committee of citizens is at work raising a bonus of $40,000 for this road, which is expected to be under construction very shortly.

Rocky Mt. and Pacific—Existing Roads.

GREAT NORTHERN.—A press dispatch says: Work on the new road, which President Hill, of the Great Northern, is to build from Kaslo City to the head of Bear Lake, was commenced last Monday. It will be pushed as rapidly as possible during the winter, and will be completed early in June next. This road will be 20 miles in length, and will follow closely the wagon road which was built a year ago, at an expense of $30,000, to tap the big mines. This will give the Great Northern a chance to compete with the Canadian Pacific, which has hitherto had a monopoly on the shipment of all ores, taking them out by way of Revelstoke, at the head of Arrow Lake.

NEVADA SOUTHERN.—This railway now extends from Goff station, on the Atlantic & Pacific Ry., a few miles west of Needles, Cal., to the Vanderbilt and New York mining districts. Mr. Blake, the president, makes the absolute statement that the road will be at once extended with all the dispatch possible to the coalfields of southern Utah. The company has secured the right of way and the means to carry its road 100 miles further than its present terminus, and that will bring the cars into the center of the coalfields of Utah. The line will also pass through a region where vast deposits of iron ore are to be found. Experts who have been over the ground state that there are only two other places in the United States where ore can be found in quantities that is suited to the production of the finest kind of Bessemer steel. This will bring the road within a comparatively short distance of Salt Lake City.

SAN DIEGO, YUMA & PHOENIX.—Steady progress is being made in the construction of this road near San Diego, Cal. The graders are now working through the large Denari-Mosto vineyard. The line now ends five miles east from Phoenix Junction and 15 miles from San Diego. A press dispatch also says: "The San Diego & Phoenix R. R. Co. has filed a bond mortgage to the Metropolitan Trust Co., of New York, as trustee, to cover the issue of $4,000,000 of 20-year 6% interest-bearing bonds, limited in issue to $20,000 per mile for each mile of the road constructed. Pres. W. H. Carlson, being interviewed, said that when 10 miles of the railroad is built the Metropolitan Trust Co. will issue to the San Diego & Phoenix R. R. Co. $200,000 of bonds, upon which a loan of $160,000 has been arranged for, and with this money another 10 miles will be completed, when another issue of $200,000 in bonds will be made, and thus the road will be built in blocks of 10 miles each through to Phoenix, Ariz., by way of Yuma. Over five miles of the road is now graded, and over three miles of the track laid. Work is going forward rapidly, nearly 1,000 San Diego citizens having pledged themselves to pay $1 per mile each as fast as the road is graded. With this local aid the completion of the first 10 miles is assured when the funds from bonds become available."

Projects and Surveys.

OAKLAND & SAN FRANCISCO TERMINAL CO.—This company has been chartered in California with a capital stock of $1,500,000, of which $700,000 has been subscribed. The articles state that the purpose of this company is to construct steam and street railroads, wharves, ferryboats and warehouses in San Francisco and Oakland. The directors for the first year are: F. M. Smith, president; A. H. Clough, W. F. Rudolph, of Oakland; F. B. Pritchard and William Thomas, of San Francisco. Mr. Smith's immediate plans, which it is the intention of the company to carry out, are as follows: The pier, partially constructed at Emeryville, will be carried out to deep water. The gage of the California & Nevada R. R. will be changed from narrow to broad, and a train service for Berkeley and the adjoining district will be inaugurated. A pier will be constructed at 17th St., which will form a V with the Emeryville pier. Upon this will be carried out by electric line or otherwise the passenger traffic from Oakland in conjunction with the Oakland Consolidated and other street railroad lines now controlled by Mr. Smith.

STREET RAILWAYS.

ABINGTON, MASS.—The directors of the Abington & Rockland Electric Ry. are considering plans for additional extensions in the direction of Hingham.

CLINTON, MASS.—The Clinton St. Ry. Co. is negotiating for a franchise to extend its line through Lancaster.

ROCKVILLE, CONN.—The Hartford, Manchester & Rockville Electric Ry. Co. has been organized and will probably commence the construction of its road in the spring. E. S. Henry is a director.

GREENWICH, N. Y.—It is reported that New York surveyors have completed the survey for an electric railway from this place to Schuylerville, by way of Middle Falls, Clark's Mills and Thompson's Mills, crossing the Hudson River at the last named place. The construction is expected to be commenced as soon as a charter has been obtained.

NEWTOWN, N. Y.—The highway commissioners have granted permission to the Brooklyn City R. R. Co. to extend its line from the Penny Bridge to the town line near Jamaica.

CARBONDALE, PA.—The Carbondale & Forest City Passenger Ry. Co. has been incorporated to build a railway between the cities named; capital stock, $150,000; Pres., John W. Aitkin.

CATASAUQUA, PA.—The Lehigh Valley Traction Co. has petitioned for a franchise granting the right of way through the borough, the road to be completed to Siegfried's bridge within 18 months after the granting of the franchise.

HARRISBURG, PA.—The Suburban St. Ry. Co. has been incorporated to build a street railway from this city to Dauphin; capital stock, $45,000. Pres., H. Kalbach, Lebanon, Pa.

PHILADELPHIA, PA.—Charters were granted Nov. 13 to the Manayunk Passenger Ry. Co. and the Penn Traction Co.; capital stock, $12,000 and $10,000, respectively.

PHILADELPHIA, PA.—The Powelton Ave. & 34th St. Passenger Ry. Co. will soon petition for permission to use electricity as motive power on its line. The road is intended as a feeder to the Zoological Garden and will be about two miles in length; capital stock, $20,000; Pres., G. A. Aldrich, Audubon, N. J.; Secy., J. S. Freeman, Philadelphia; Treas., A. H. Logan, West Philadelphia.

SHAMOKIN, PA.—Work is about to be commenced at this place on the proposed Shamokin & Mount Carmel Electric Ry.

SPRING CITY, PA.—The council has granted a franchise for an electric street railway to the Schuylkill Valley Illuminating Co. The road will extend from Valley Forge through Phoenixville to this place, and the construction will be commenced next spring.

RANDALLSTON, MD.—H. M. Benzinger, R. B. Chapman and W. M. Baker are members of a committee appointed to solicit subscriptions for an electric railway to connect this place with one of the electric lines extending into Baltimore. Several routes have been suggested.

NORTH BALTIMORE, O.—The council has loaned John Geghan $7,000 to aid in constructing the electric railway to Welker. The road is expected to be in operation by Jan. 1.

GOSHEN, IND.—The Indiana Electric Power Co. has been granted until April 1, 1895 for the construction of the projected electric railway between this city and Elkhart, the right of way for which was granted some time ago.

MILWAUKEE, WIS.—The Milwaukee & Whitefish Bay Rapid Transit Co. has been organized by Fred Isenring, Max Zabel, Robt. Gether and others. The road will run along Humboldt Ave.

WEST DULUTH, MINN.—A franchise has been granted to Col. A. A. Harris, a part of the road to be in operation by Nov. 1, 1894, and the entire line by July 1, 1895.

LAWRENCE, KAN.—Holland Wheeler, Ex-Cy. Engr., has petitioned for a franchise for a cable railway on Mount Oread, from the base of the hill to its summit, to reach the State University buildings.

ST. LOUIS, MO.—The St. Louis County St. Ry. Co. is reported as planning to extend its line, now in course of construction along Lucas and Hunt road, from Wellston, the eastern terminus on the St. Charles Rock road, where it connects with the St. Louis and Suburban and Citizens' lines, to Ferguson, by way of Normandy.

MANITOU, COLO.—The Manitou Electric Ry. & Casino Co. has been incorporated by M. A. Leddy, John Hulbert, P. S. King and others; capital stock, $125,000.

OAKLAND, CAL.—A. H. Breed and J. H. Daniels have petitioned the supervisors for a franchise, and the clerk has been instructed to receive bids for the same until Dec. 26.

BELLEVILLE, ONT.—A committee of the council has considered favorably the proposition of the Canadian General Electric Co. for a street railway in this place.

PRESTON, ONT.—It is reported that the arrangements are now complete for the construction of the Galt & Preston Electric Street Ry. It is the intention to have all the material on hand this winter, and to build the road as soon as possible in the spring. A charter has also been secured for a line to connect this city and Berlin, which may be constructed in the

ELEVATED RAILWAYS.

CHICAGO, ILL.—The Northwestern Elevated Ry. Co. has been incorporated by Edward W. Russell, B. J. Arnold and Harold Sturgis, Chicago, and Frederick Sargent, La Grange, Ill. It is proposed to use a new electric motor.

HIGHWAYS.

MASSACHUSETTS.—The commissioners of Plymouth county are considering a petition for a highway six miles long in Wareham, Plymouth and Carver, through the cranberry growing district, for the benefit of the bog owners, two miles of the road to be in each one of the towns. If laid out the road will run by the side of the largest cranberry bog in the world, which yielded 18,000 barrels this season, according to reports.

WASHINGTON.—The commissioners of Whatcom county are about to begin the improvement under the new road law of three main roads radiating from New Whatcom, the county seat. The cities benefited are to pay one-sixth of the cost, the county one-third, the road districts traversed one-sixth, and the remaining one-third will be assessed against abutting property. Contracts will be let in small sections and to resident taxpayers, and warrants issued for the work will be received in payment of the special improvement taxes levied to defray the cost. It will be the first work under the new law in this part of the state.

IDAHO.—The delay in securing pay for the wagon road bonds is reported to have caused a postponement until next year of the construction of the projected state roads.

BRIDGES.

FAIRFIELD, ME.—There is talk of several new bridges at this place. An engineer of the Maine Central R. R. is stated to have reported in favor of condemning one of the old bridges at once.

BOSTON, MASS.—The aldermen have voted in favor of a loan of $1,000,000 for the construction of a new bridge to Charlestown, in place of the present Charles River bridge. This is in accordance with the report of the city engineer and recent recommendation of the mayor.

PROVIDENCE, R. I.—It is reported probable that the red bridge connecting this city and East Providence will soon be rebuilt. The weight of loads passing over the bridge was recently reduced and the Union R. R. Co. has decided it unsafe to run cars over the bridge, for which it was granted a franchise some time ago.

NIAGARA FALLS, N. Y.—The new bridge projected to carry the Grand Trunk Ry. across the gorge at this place will be a single arch steel structure about 600 ft. long, and is estimated to cost $500,000, according to reports.

ROCHESTER, N. Y.—The city surveyor has recommended the construction of an iron girder bridge, estimated to cost about $12,000.

PITTSBURG, PA.—D. P. Corwin, Ralph Baggaley, John Scott, F. E. Moore and Henry Phipps, Jr., are reported as interested in the Mendelssohn & Glassport Bridge Co., which proposes to construct a new railway and passenger bridge between the places named.

BALTIMORE, MD.—Bids are asked until Nov. 27 for the reconstruction of the bridge over Jones' Falls on the line of Maryland Ave. A. E. Smyrk, Cy. Comr.

ATLANTA, GA.—The council has adopted the plans of the American Bridge Co. and Henry T. McDaniel for the Alabama St. bridge.

LUDLOW, KY.—Bids are asked until Nov. 29 for a highway bridge, five 30-ft. girder spans, 26.6-ft. roadway and one 8-ft. sidewalk. J. J. Weaver, Cy. Engr.

CINCINNATI, O.—The county commissioners have authorized Frank King, Engr., to prepare plans for a new bridge at Venice. It will have one span of 385 ft. and is estimated to cost $65,000.

ALTON, ILL.—A bridge on the Chicago & Alton R. R. near Godfrey has been destroyed by fire.

DULUTH, MINN.—The joint committee of this city and Superior have decided to petition Congress for permission to build a combination railway, street railway, foot passenger and wagon bridge between the two cities. The bridge will be of steel and is estimated to cost about $350,000.

RED WING, MINN.—The council has engaged C. F. Loweth, St. Paul, to prepare plans for the proposed wagon bridge across the Mississippi River at this place, for which $75,000 of bonds were recently voted.

ST. CLOUD, MINN.—The council has voted to advertise for bids for a steel bridge estimated to cost about $45,000. Frank Smith, Cy. Engr.

ST. PAUL, MINN.—The city engineer is preparing plans for certain bridgework.

KILDARE, TEX.—The citizens of this city, Cherokee and Willow Springs have appointed I. N. Blakemore, Calvert Ferguson and D. Rasure members of a committee to supervise the construction of bridges between this place and Blackwell, the work to be commenced at once.

SPOKANE, WASH.—Several piers of the bridge carrying the Great Northern Ry. over Boulder Creek at Leonia, Idaho, were washed away Nov. 5.

TACOMA, WASH.—The following bids have been received for the construction of the Union Ave. bridge: Alexander Gillard, $5,332; M. E. Hansen, $5,475; James Lee, $5,490; J. F. Hopping, $5,540; Link & Estes, $6,385.

WINNIPEG, MAN.—The city engineer has been directed to report on proposed work to cost between $100,000 and $200,000.

WATER-WORKS.

AUBURN, ME.—The board has elected Albert Haskell superintendent and voted to place meters in all the stables.

BATH, ME.—The citizens have voted not to ratify the action of the council granting permission to the Maine Water Co. to secure a supply from Nequasset Lake, in Woolwich, instead of from Thompson's Brook, in Brunswick, which has been the source of supply for six years, but to permit the use of Nequasset Lake water only as an addition to the present supply.

SOUTH BERWICK, ME.—The earthwork of the reservoir of the Burleigh Water-Works Co. gave way Nov. 5 causing a damage of $2,000, according to reports.

BURLINGTON, VT.—The contract for extending the intake into the lake has been awarded to J. G. Falcon, Evanston, Ill., at $47,900.

GROTON, VT.—A reservoir is being built by B. F. Clark and others to secure a supply for the village.

ARLINGTON, MASS.—Tests are being made for increasing the supply.

BEVERLY, MASS.—Surveys are reported as nearly completed for the proposed new supply.

BOSTON, MASS.—The board states that the supply from Mystic Lake should be filtered or entirely abandoned. A filter plant would cost $575,000, and $150,000 is recommended for new pumps, boilers and an engine house.

BROCKTON, MASS.—The aldermen have authorized an issue of $62,000 of 30-year 4% bonds for extensions.——The residents of Brockton Heights and Cary Hill have petitioned for extensions to those districts. This would require an additional stand-pipe and pumping station.

BROOKLINE, MASS.—About a mile of 20 to 16-in. pipe will be laid and 400 wells, 2½-in. and 20 to 40 ft. deep, driven.

LENOX, MASS.—Larger reservoirs are proposed.

MEDFORD, MASS.—The commissioners have been authorized to establish a pumping station at Wright's Pond; appropriation, $10,000.

SALEM, MASS.—The question of an increased supply is being considered.

JAMESTOWN, N. Y.—The board of public works has been directed to sell $250,000 of water bonds.

PAULSBORO, N. J.—It is reported that works are being put in.

ALTOONA, PA.—Bids are asked until Nov. 18 for an impounding reservoir. Bids for this work were to have been opened Sept. 19 but owing to an injunction no bids were received, as stated in our issue of Sept. 28. C. A. Martin, Secy. Comrs.

ETNA, PA.—The company has decided not to sell the works, for the purchase of which the borough recently voted bonds for $85,000.

LIGONIER, PA.—An election will be held Nov. 28 to vote on an issue of bonds for works.

LILLY, PA.—The Lilly Water Co. has been incorporated by J. B. Mullen, J. L. Armitage, John Leahey, and others; capital stock, $10,000.

NORRISTOWN, PA.—The authorities of the insane asylum are reported as about to erect a reservoir on a hill a mile from the buildings.

PAOLI, PA.—The Paoli Water Co. has been incorporated; capital stock, $1,000; Treas., David B. Hedley.

PHILADELPHIA, PA.—Bids have been opened for work to cost nearly $750,000 at the Queen Lane reservoir, the prices for 20,000,000-gallon pumping engines ranging from $65,000 to $120,000; for 24 boilers, $95,000 to $131,000; engine and boiler house, $152,430 to $181,941.

WASHINGTON, PA.—The Citizens' Water Co. is reported as about to receive bids for sinking one or more 12-in. wells to secure an increased supply.

WASHINGTON, D. C.—The district commissioners will receive bids until Nov. 25 for cast iron pipe.

AIKEN, S. C.—Bids are asked for works, including stand-pipe, reservoir, piping, hydrants, and 35 to 50-HP. steam engine. M. B. Woodward, Chn. Com.

ATLANTA, GA.—It is reported that H. P. Malone, Altoona, Pa., has been awarded a contract for 17 miles of extensions, work to be commenced in January.

ATHENS, TENN.—W. C. Hornsby is interested in projected works.

CYNTHIANA, KY.—The citizens have voted, 302 to 138, in favor of bonds for $40,000 for works.

ELMWOOD PLACE, O.—The question of works and an electric light plant was defeated Nov. 7 by a vote of 192 for to 200 against an issue of bonds for $30,000.

LOCKLAND, O.—A special election will be held Dec. 11 to vote on an issue of bonds for $20,000 for works.

MARIETTA, O.—It is stated that several thousand feet of 4 and 6-in. pipe will be laid the coming season and an extra line under the Muskingum River, connecting the system of the two sides of the city.

NORWALK, O.—An election will be held next month to vote on an issue of bonds for $4,000 for improvements, including the laying of a quantity of 16-in. pipe.

WAPAKONETA, O.—The council is considering an issue of bonds for $40,000 for works to be built in the spring.

ALEXANDRIA, IND.—It is reported that works will soon be put in.

NEW HAVEN, IND.—Works were recently voted for and it is thought that steps will soon be taken to put in a system.

HOWELL, MICH.—The contract for works has been awarded to Max Walker, Trenton, at $27,908, not including wells and engine house.

LANSING, MICH.—The council is considering the purchase of a 5,000,000-gallon Worthington pumping engine recently exhibited at the World's Fair.

MARSHALL, MICH.—Plans are being prepared for new works to be owned by the city.

BLUE ISLAND, ILL.—Bids are asked until Nov. 20 for pipe in seven streets. Fred. Hohmann, Vil. Clk.

OTTAWA, ILL.—Propositions are being considered for new works, but it is reported that the city will build its own works.

PANA, ILL.—An election was held last week to vote on the question of works.

BERLIN, WIS.—Bids are asked until Jan. 2 for works. Henry Morman, Cy. Clk.

OCONOMOWOC, WIS.—The yacht club is agitating the question of works and a sewerage system.

CEDAR RAPIDS, IA.—The board has reported that the pumping capacity of the water company is insufficient for fire protection.

FAIRMOUNT, MINN.—The citizens are reported to have voted to issue bonds for $20,000 for works and electric lights.

CASPER, WYO.—Preliminary surveys have been completed for works, for which bonds were recently voted. The plans include a 1,188,000-gallon reservoir; estimated cost of works, $26,670.

BOWIE, TEX.—The question of works is being agitated, according to reports.

CORSICANA, TEX.—The city is being urged to put in works and secure an artesian supply. Works were built here in 1884 by the Corsicana Water Co., but the service is reported as not satisfactory.

HEMPSTEAD, TEX.—Efforts are being made to secure works, the supply to be from artesian wells.

LLANO, TEX.—A new pump has been purchased and the superintendent is reported as negotiating for two car loads of pipe.

TAYLOR, TEX.—The company will soon make extensions, including the laying of 12,000 of additional mains in west side of the city.

WAXAHACHIE, TEX.—The council has granted an extension of 60 days time to the water-works company for commencing work, provided a deposit of $500 is made.

BARNUM, COLO.—A franchise has been granted to the Mountain Water Co. to lay mains in certain streets. About 4,600 ft. of pipe will be laid and nine hydrants put in.

SAN LUIS POTOSI, MEX.—A company has been organized to put in works.

SUDBURY, ONT.—Willis Chipman has prepared plans for works.

WINDSOR, ONT.—The council has voted to issue bonds for $30,000 for extensions.

BUCKINGHAM, QUE.—A by-law will soon be presented to enable the council to borrow $25,000 to complete the works and electric light plant.

ARTESIAN WELLS.

WASHINGTON, D. C.—The Commissioner of Indian Affairs will receive bids until Dec. 7 for boring artesian wells in Pine Ridge, Rosebud and Standing Rock Indian reservations in South Dakota.

BLUE ISLAND, ILL.—Bids are asked until Nov. 20 for boring an artesian well 2,100 ft. deep. Fred Hohmann, Vil. Clk.

LAKE CRYSTAL, MINN.—An 8-in. well will be sunk, the depth to be 1,000 ft. unless a sufficient supply of water is reached at a less depth.

BRICEVILLE, TEX.—It is reported that an artesian well will soon be sunk.

ROSEBUD, TEX.—A company has been formed to sink an artesian well and bids will soon be received for the work.

IRRIGATION.

STOCKTON, CAL.—The Woodbridge Irrigation Co. has commenced work on an extension of the irrigation canal to the Calaveras River, a distance of six miles, making the canal 19 miles long. About 60 men and 150 horses are employed on the work, which will cost $40,000. The canal will be 7 ft. deep and 39 ft. wide at the top.

LAS CRUCES, N. MEX.—The Rio Grande Dam & Irrigation Co., which was incorporated some time ago by E. O. Roberts, E. V. Berrien, J. L. Campbell and others, capital stock $5,000,000, proposes to construct storage reservoirs near old Fort McRea, 35 miles south of Fort Craig, that will create a lake in the Rio Grande basin about 35 miles long and which will back the waters of the Bravo, which are abundant but very sluggish at this point, up to the locality of Paraje. From this reservoir will be irrigated some 300,000 acres of land in Socorro, Sierra and Dona Ana counties in New Mexico, and El Paso county, Tex., taking in the very best of the lower Rio Grande valley from Palomas, N. Mex., to Fort Hancock, Tex. The first cost of this enterprise will be over $3,000,000, according to reports.

NEW COMPANIES.—West Side Consolidated Ditch Co., Huron, Cal.; $15,000; Chas. Fall, Lemoore; Z. R. Stevens, T. D. Hawkins and others, Huron.——Chaffee Ditch & Canal Co., Buen Vista, Colo.; $50,000.——Deming Land & Water Co., Deming, N. Mex.; $700,000.

SEWERS.

BOSTON, MASS.—Bids are asked until Nov. 18 for the construction of a sewage disposal system at the new Lunatic Hospital, West Roxbury. E. M. Wheelwright, Cy. Architect.

BROCKTON, MASS.—The aldermen have authorized an issue of $100,000 of 4% 30-year bonds to complete the sewerage system.

NEWBURYPORT, MASS.—The council has authorized the city treasurer to issue $30,000 of 4% sewer bonds.

SPRINGFIELD, MASS.—The city engineer is preparing plans for a storm water sewer to relieve the Garden brook sewer, in ward 1; estimated cost, $25,000 to $30,000.

PROVIDENCE, R. I.—Bids are asked until Dec. 2 for five contracts for 74 to 102-in. brick sewer, average cut 20 to 26 ft. Robt. E. Smith, Comr. Pub. Wks.

NEW BRITAIN, CONN.—The city is negotiating the sale of a large amount of sewer bonds, according to reports.

JAMESTOWN, N. Y.—The contract for the south side sewers has been awarded to Wm. Franklin, Buffalo, at about $58,000. The work will be commenced at once, local laborers to be employed and at wages not less than $1.50 per day. The total bids were published in our issue of Nov. 2.

NEWBURG, N. Y.—The contract for a trunk sewer in West Newburg has been awarded to Babcock, Lary & Co., Newburg, at $125,127. The award was previously made to M. Sullivan & Co., at $109,054, as stated Oct. 26, but Mr. Sullivan refused to sign the contract. The total bids were published Oct. 19.

ALLEGHENY, PA.—The comptroller has sold $250,000 of sewer and street bonds at par.

CHESTER, PA.—Bids are asked until Nov. 20 for a terra cotta sewer in one street. M. Lewis, Cy. Clk.

KITTANNING, PA.—The citzens have voted to issue bonds for $30,000 for a system.

PHILADELPHIA, PA.—Contracts have been awarded for work to cost about $237,000, including the following: Geo. W. Ruch, at about $15,000; C. P. Grim & Co., $22,000; R. P. Bennis, $24,000; W. H. H. Achuff, $60,000.—The estimates for next year include $1,000,000 for main sewers, $500,000 for branch sewers, $275,000 for the completion of the Aramingo sewer and $100,000 for interception sewer work.

READING, PA.—Bids are being asked by the council, according to reports, for the construction of a house sewer system in the first district, population about 20,000. The sewage will be collected in the lowest part of the city and thence pumped outside of the city where it will be purified by filtration or by broad irrigation.

HUNTSVILLE, ALA.—Surveys are being made for a complete system.

AURORA, ILL.—Bids are asked by the city clerk until Dec. for $30,000 of sewer bonds.

FARGO, N. DAK.—Bids are asked until Dec. 4 for a main sewer in Fourth St. A. O. Rupert, Cy. Aud.

NEVADA, MO.—It is reported that a contract has been awarded to Lillis & Glennon, Springfield, at about $35,000, the work including the extending of the main about two miles from the present outlet.

TACOMA, WASH.—The following bids were received for constructing the East I St. sewer to the head of the bay, the estimated cost being $6,000: M. O. Johnson & E. Eugene, $4,999; James Lee, $5,693; Oppermanns & Berens, $4,200; Gribble & Thurs, $3,993; Link & Estes, $4,500; J. F. Hale, $3,985.

CHARLOTTETOWN, PRINCE EDWARD ISLAND.—A sanitary association has been formed to secure the construction of a system. Plans were prepared some time ago by Geo. E. Waring, estimating the cost at $133,000. Address Donald Nicholson.

STREETS.

MOUNT VERNON, N. Y.—Bids are asked until Nov. 21 for paving with asphalt. E. G. Pease, Cy. Clk.

NEW YORK, N. Y.—Bids are asked until Nov. 27 for eight contracts for asphalt and granite paving, flagging, etc. M. T. Daly, Comr. Pub. Wks.——Bids are asked until Nov. 28 for seven contracts for grading, paving, etc. L. F. Haffen, Comr. St. Impvts., Wards 23 and 24.

TROY, N. Y.—Bids are asked until Nov. 21 for paving with granite blocks. E. Ogden Ross, Secy. Bd.

CHESTER, PA.—Bids are asked until Nov. 20 for paving in two streets with brick. M. Lewis, Cy. Clk.

LANCASTER, PA.—The committee has reported favorably an ordinance providing for an issue of bonds for $300,000 for paving and sewers.

LEBANON, PA.—The council has decided to spend $10,000 in street improvements in order to give work to the unemployed of that city.

PHILADELPHIA, PA.—Bids are asked until Nov. 20 for macadamizing, repaving, etc. Jas. H. Windrim, Dir. Pub. Wks.

TOLEDO, O.—Bids are asked until Nov. 20 for paving with cedar blocks, brick or Medina stone. Sylvester Lamb, Cy. Clk.

CHICAGO, ILL.—Bids are asked until Nov. 20 for improving 18 streets and alleys. H. J. Jones, Comr. Pub. Wks.

DUBUQUE, IA.—The finance committee has sold $50,000 of 6% paving bonds, running seven years, at 1% premium.

OTTUMWA, IA.—Bids are asked until Nov. 20 for paving with vitrified brick. A. W. Buchanan, Chn. St. Com.

DE SOTO, MO.—Bids are asked until Nov. 27 for improving Main St. A. L. Colman, Cy. Clk.

ELECTRIC LIGHT AND POWER.

DEERING, ME.—The contract for street lighting for five years from Dec. 1 has been awarded to the Deering Electric Light Co., at $85 per light per year for nine 1,200-c. p. arc lights and $17 per light for 131 incandescent lights, 25-c. p., moonlight schedule; or $95 and $20 if the lights burn from dusk till daylight without regard to the moolight. The plant will be erected at once.

WOODFORD'S, ME.—The contract for the power house for Marsh Bros.' electric plant has been awarded to N. E. Redlon & Son.

SUNAPEE, N. H.—It is reported that the Concord Electric Light Co. is negotiating for putting in a plant at that place.

NORTHAMPTON, MASS.—The Northampton Electric Light Co. has voted to build a new plant on West St., at a cost of $60,000, the contracts to be let as soon as possible.

KEARNEY, N. J.—Bids are asked until Dec. 12 for lighting the streets for three or five years from April 1, 1894. Wm. Smith, Tn. Clk.

AMBLER, PA.—The citizens have voted to take action to secure a municipal electric light plant.

ELMHURST, PA.—There is talk of organizing an electric light company here, using water power to generate the electricity.

HANOVER, PA.—A committee has been appointed to prepare specifications for proposals for electric street lighting.

LANSING, MICH.—The citizens have voted 150 to 1 in favor of the proposed issue of bonds for $60,000 for a municipal plant.

FARGO, N. DAK.—Bids are asked until Dec. 6 for an electric light plant in the county courthouse, including a 10½-HP. gasoline engine and a 110-incandescent light dynamo; also for wiring the building. C. H. Anheier, Co. Aud.

HELENA, MONT.—It is stated that within the past few weeks surveys for the Missouri River dam above Canyon Ferry have been advanced to completion, and the engineer's report will soon be completed. If carried to completion this will result in the transmission of electric power to Helena sufficient for all the needs of street railway operation, with a large surplus to be applied to other purposes.

DALLAS, TEX.—The city electrician has prepared plans for an electric light plant for 300 arc lights; estimated cost, $58,472.

ST. CHARLES, MO.—Schrantz & Middlekamp, Warrenton, have petitioned for a 25-year franchise for both arc and incandescent lighting. The St. Charles Light & Fuel Co. is reported as also wishing a franchise.

ALAMEDA, CAL.—The board of trade is trying to secure an incandescent circuit for the city, according to reports.

LONDON, ONT.—Bids are asked until Nov. 30 for a plant for arc lighting, including boilers, engines, etc. A. Ormsby Graydon, Cy. Engr.

NEW COMPANIES.—Pittsburg Electric Co., Pittsburg, Pa.; $5,000; to furnish electric lights at South Pittsburg; Wm. M. Gillespie, Pittsburg; J. A. Curry, Wilkinsburg.——Muncey Electric Light, Heat & Power Co., Muncey, Pa.; $20,000; Treas., D. B. Dykens.——Old Dominion Electrical Const. Co., Richmond, Va.; $25,000; Pres., M. W. Thomas; Treas., M. Hunter.——Commercial Electric Engineering Co., Detroit, Mich.; $50,000; Jos. Billore, G. E. Fisher, O. D. Chase.——Cataract General Electric Co., New York, N. Y.; $8,000; Wm. Mertens, Thos. C. Platt. F. W. Hawley.——Baker Electric Lamp Co., Portland, Me.; $400,000; to manufacture arc and incandescent lamps under Cutler's patent granted to Elbridge Baker; Pres., F. A. Whiting, Lowell, Mass.; Treas., C. A. Stillman, Lynn, Mass.——Canisteo Electric & Fuel Gas Co., Canisteo, N. Y.; $50,000.——Riverhead Electric Light Co., Riverhead, N. Y.; $7,500; J. R. Perkins, J. H. Perkins, T. M. Griffing.——East Hartford Electric Light & Power Co., East Hartford, Conn.; Pres., P. S. Bryant; Treas., L. S. Forbes.——Colorado Novelty & Electric Co., Colorado Springs, Colo.; Man., J. E. Jeanne.

CONTRACT PRICES.

COBBLESTONES.—Baltimore, Md.—The following bids have been received for cobblestones for macadamizing: Geo. W. Hennich, $1 per perch; Smith & Schwarz, 75 cts.; E. R. Shipley, $1.10; G. W. Hare, 99 cts.; F. M. Ketchum, $1.35; Patrick Crehan, $1.24.

BREAKWATER.—Washington, D. C.—The contract for the construction of stone breakwater near Bar Harbor, Mount Desert Island, Me., has been awarded to Wm. S. White, Rockland, Me., at 97 cts. per ton, work to be commenced May 1, 1894, and to be completed Nov. 1, 1894.

PIPE.—Waterbury, Conn.—The contract for 30,000 ft. 36-in. cast iron pipe and 200 tons special castings has been awarded to the Chattanooga Foundry & Pipe Works, Chattanooga, Tenn., at $23.52 per ton of 2,240 lbs. for the pipe and 2.5 cts. per lb. for special castings. Other bids ranged from $23.62 to $25.98 per ton for pipe and 2.4 cts. to 2.9 cts. per lb. for specials.

MACADAMIZING.—Paterson, N. J.—The following bids have been received for macadamizing 3,000 lin. ft. of East Fifth St: Geo. W. Colfax, 31 cts. per sq. yd. for 4 ins. macadam; H. Post, 28 cts.; McKiernan & Bergin, 30 cts.; Nelson Kason, 34½ cts.; Ekings & Burger, 27½ cts.; Jas. Finnegan, 27½ cts. It is stated that the usual price for this work is 40 cts. per sq. yd.

BRICK PAVING.—New Castle, Pa.—In our issue of Nov. 2 we stated that the contract for paving Court St. with brick had been awarded to Funkhouser & Coates, for Porter & Co.'s West Virginia firebrick. We are informed by the Park Fire Clay Co., Pittsburg, Pa., that this was an error, as the contract was awarded to W. A. Park, for the Park Fire Clay Co.'s brick, its brick having stood highest in the test that was made.

LEVEE WORK. New Orleans, La.—Capt. John Millis, U. S. Engineer Office, has received the following lowest bids: Pontchartrain district, Lower Hope levee, 16,000 cu. yds., Manning & Gibson, 11 cts. per cu. yds.; Good Hope, 50,000 cu. yds., Jeffries & Dameron, 11 cts.; Rost, 32,000 cu. yds., John Mahoney, 10.89 cts.; Modoc, 15,000 cu. yds., Manning & Gibson, 11 cts.; Frellsen, 23,000 cu. yds., Hayes Bros., 10.25 cts.; Laurel, 27,000 cu. yds., and Lower Ben Hur, 37,000 cu. yds., R. M. Quigley & Co., 11.47 cts.; Towles to Billings, 15,000 cu. yds., enlargement, R. M. Quigley & Co., 16.47 cts.; Lake Borgne districts, Sugar House, 8,500 cu. yds., I. R. Bobbitt, 14.50 cts.; Merritt, 32,000 cu. yds., John Mahoney, 13.85 cts.; Stella, 20,000 cu. yds., Jeffries & Dameron, 13 cts.

REMOVING LOAM.—Clinton, Mass.—We stated Nov. 2 that the contract for removing 26,000 cu. yds. of loam from the Lyndes reservoir had been awarded to Thos. F. Meany & Co., Quincy Point. The price was 27 cts. per cu. yd., and the other bids as follows: H. F. Burt, Taunton, 30 cts.; Megan & Co., Stoneham, 33 cts.; D. J. Cronin, Campello, 34 cts.; John F. Moran, Chelsea, 35 cts.; A. Saucier, South Framingham, 37 cts.; J. D. Fallon & Co., Boston, 39 cts.; L. Leighton & Co., Clinton, 40 cts.; Thomas Hennessey, Jefferson, 44 cts.; Neil McBride, Brighton, 47 cts.; Weaving, Booth & Co., Quincy Point, 47 cts.; Joseph Burns, Boston, 64 cts.; W. H. Hastings, South Framingham, 67 cts.; David Hall, Boston, 67 cts.; E. F. Jones & Co., Everett, 68 cts.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

BONDS.—Bay City, Mich.—The city has sold $75,000 of city hall bonds and $24,500 of local improvement bonds.

PARK IMPROVEMENTS.—Cleveland, O.—The boulevard commission has voted to issue $500,000 of bonds for park extensions and improvements.

CHEMICAL ENGINE.—Easton, Pa.—Bids are asked until Nov. 20 for a chemical fire engine with double tank, capacity 35 gallons each. L. M. Fine, Cy. Clk.

GARBAGE CREMATOR.—Dallas, Tex.—The city secretary has been authorized to advertise for bids for the erection of a garbage crematory of a capacity of 75 cu. yds. daily of miscellaneous garbage and night soil; also bids to construct such a crematory and to operate the same for three years.

WATER POWER.—Keewatin, Ont.—The Keewatin Power Co. is reported as preparing to construct dams to develop 35,000 to 40,000 HP. near this place. A large amount of the $1,000,000 capital stock of the company has been paid in and the work of construction is expected to be pushed as rapidly as possible; Pres., Richard Fuller, Hamilton; Vice-Pres. and Chf. of Const., John Mather, Keewatin; Engr., Wm. Kennedy; Consult. Engr., John Kennedy.

LEVEE WORK.—Edwardsville, Ill.—It is stated that the Chouteau, Natheoki and Venice drainage and levee district will spend $160,000 in strengthening its levees, the top of which will be made 12 ft. wide instead of 6 ft.

Memphis, Tenn.—Bids will be received at the U. S. Engineer Office until Dec. 5 for about 335,000 cu. yds. work in the lower Yazoo districts. Capt. C. McD. Townsend, U. S. A.

INDUSTRIAL NOTES.

RAILS.—The Carnegie Steel Co., of Pittsburg, Pa., has reduced its price for steel rails from $29 to $24 per ton, having decided to leave the Steel Rail Association and make its own prices.

CARS.—The Barney & Smith Car Co., of Dayton, O., is building vestibuled day cars for the Minneapolis, St. Paul & Sault Ste. Marie. The Barr vestibule is used, being supplied by the Drexel Railway Supply Co., of Chicago.

STEEL WORKS.—The Illinois Steel Co. is reported as intending to reopen its plant at Joliet on Dec. 1.

THE PLENTY HORTICULTURAL & SKYLIGHT WORKS, of Jersey City, has been sold to its former proprietor, Mr. Josephus Plenty, who will continue the business under his own name and in the same style as before he sold out. Mr. Plenty is the sole American agent for the Helliwell patent system of glazing for the glass roofs of shops, factories, trainsheds, etc.

THE NEW YORK MASTIC WORKS, New York, agents for the Seyssel rock asphalt, are laying asphalt at the House of Relief, the German Hospital, and the Museum of Natural History, New York, and in the new railway building at New Haven. At Providence, R. I., they are doing work in the Arcade Block, through their Rhode Island agents, the Smith Concrete Co., of Providence.

CAR HEATING BY STEAM was an experiment little more than half a dozen years ago; and many railway men were firm in the belief that it could not be made practically successful. It is interesting to recall this in connection with the announcement by the Consolidated Car Heating Co., of Albany, N. Y., that its total sales have just passed the million dollar mark. The company was organized in August, 1889, and at the close of business on Nov. 4 its total sales had amounted to $1,003,598.89.

NEW COMPANIES.—Southwest Construction Co., Kansas City, Mo.; $150,000; F. O. Hadley, Louis M. Erb and George H. Adams. C. A. C. Tie Plate Co., Elizabeth, N. J.; $500,000; A. Clark and H. T. Alexander, of Elizabeth, and J. Churchward, of Brooklyn, N. Y. Buffalo Heating & Ventilating Co., Buffalo, N. Y.; $5,000; W. F. Wendt and Louis F. Barchard. J. C. Mott Granite Co., Joliet, Ill.; $40,000; John C. Mott, T. H. Winter and John J. Griffith. Nichols Hydraulic & Power Co., Denver, Colo.; $150,000; W. G. Melville, S. M. Nichols and Z. F. Crider.